Feasibility Report Appendixes

December 1991

American River Watershed Investigation, California

VOLUME 5 - APPENDIXES O-R

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American River Watershed Investigation, California

FEASIBILITY REPORT

LIST OF APPENDIXES

American River Watershed Investigation, California

APPENDIX O

Real Estate

REAL ESTATE APPENDIX

1. **Introduction.** This appendix presents the real estate requirements for the selected plan to provide critically needed flood protection for urban areas along and adjacent to the lower American River in the vicinity of Sacramento, California. The Corps' authorization for its one-year reconnaissance study was included in the 1987 Appropriations Act. Authorization for additional study was included in committee language accompanying the Fiscal Year 1988 Continuing Appropriations Act (Public Law 100-202, dated December 22, 1987).

2. **General Description of Real Estate Requirements.** The study area encompasses the American River drainage basin plus flood-prone areas immediately downstream. The study area includes portions of Placer, El Dorado, Sacramento, Yolo, and Sutter Counties. The selected plan, which will provide a 200-year level of protection, includes an upstream "dry" dam and detention basin with no permanent storage or dead pool space. The dam and detention basin are along the upper American River in Placer and El Dorado Counties.

Full protection of existing development in the Natomas basin, which extends from Sacramento County into Sutter County, will be provided through modification of existing levees in various locations around the perimeter of the basin. On Arcade and Dry Creeks just east of Natomas, levees will be extended or constructed. The selected plan also includes recreation trails which will be built on levee right-of-way on the east side of the Natomas basin.

a. **Upper American River Real Estate.** The real estate requirements in the upper American River area include unpopulated steep terrain along the North and Middle Forks of the American River. The selected plan includes fee lands for the dam site and environmental mitigation lands; permanent easements for roads and the detention basin; and temporary easements for haul roads, disposal and staging areas. The permanent easements include easements for occasional flooding (5932 acres) and easements for roads and highways (52 acres total). Borrow material is expected to be available through the lease of an existing quarry. The selected plan will require that mineral claims within the detention basin be subordinated to a flowage easement or right-of-way. Currently one unpatented mining claim has been identified within the limits of the selected plan.

UPPER AMERICAN RIVER REAL ESTATE REQUIREMENTS				
CONTRACT	Acres Fee	Flowage Easements	Road Easements	Temporary Easements
FOUNDATION AND MITIGATION	5485			99
EMBANKMENT AND DETENTION BASIN	Included above	5932		Included above
RELOCATIONS			52	15
TOTAL	5485	5932	52	114

Real estate acquisition issues at the upper American River area are complex because the majority of the land is currently under the jurisdiction of the U. S. Bureau of Reclamation (USBR), the U. S. Bureau of Land Management (BLM), and the U.S. Army Corps of Engineers (Corps). The real estate requirements for the selected plan dam and detention basin are within the limits of the USBR's Auburn Dam Project which was authorized in 1965. In anticipation of its 42,410 acre project, the USBR acquired 18,900 acres from private landowners and withdrew several thousand acres of public domain land from BLM. Less than 15 percent of the 6,032 acres needed for the flood control dam and detention basin is privately owned. The USBR and BLM have been consulted throughout the course of the real estate studies. The statements in this report reflect the agreements reached among the agencies involved.

As an item of local cooperation, it is the obligation of the non-Federal sponsor to provide without cost to the United States all lands, easements, and rights-of-way necessary for construction and maintenance of the flood control project. The non-Federal sponsor will provide a right-of-entry for construction over those lands for which it obtains the necessary rights. Otherwise, the Corps will obtain the necessary rights from Federal agencies. Special provisions will be included in the Local Cooperation Agreement (LCA) to cover the costs and credits allocable to fee lands which will remain in Federal ownership and easements which were obtained at no cost from Federal agencies. Regardless, all lands currently under Federal ownership will be retained by the Federal Government.

The dam site, which would normally be acquired in fee by the non-Federal sponsor, is currently owned by the USBR. The Corps will act on behalf of the non-Federal sponsor to obtain a joint use permit to cover the lands needed for the dam site. Within the detention basin, the non-Federal sponsor will be required to obtain easements from private landowners and the USBR. Representatives of the USBR have indicated that as long as its project is still

authorized, the USBR will sell flowage easements for occasional flooding to the non-Federal sponsor since flowage easements are compatible with the USBR's authorized project. The USBR will retain its underlying fee title as long as its project is still authorized.

With regard to the public domain lands administered by BLM, the Corps may act on behalf of the non-Federal sponsor to obtain a right-of-way for occasional flooding. The Corps will assume this responsibility because of the potential revocability of rights-of-way granted by BLM to non-Federal entities; rights-of-way issued to a Federal agency are not unilaterally revokable. Should it be determined that the non-Federal sponsor can obtain adequate rights-of-way from BLM, the responsibility to acquire the right-of-way for occasional flooding may revert to the non-Federal sponsor. The right-of-way that will be obtained will not preclude mining claims but will be paramount to any such claims filed after the right-of-way is granted.

Between 1938 and 1942 the Corps acquired 74 acres in fee and 795 acres in flowage easement for the North Fork debris dam which is within the limits of the proposed detention basin. In addition, the Corps withdrew 538 acres of public domain land. The USBR has since acquired the underlying fee title to most if not all of the 795 acres covered by the flowage easement. The entire area has been permitted by the Corps to the USBR for use, occupancy and management since 1979. The current permit will expire in February 1994.

The debris dam forms Lake Clementine which is used for boating, water skiing and camping. In major storm events, the dam and recreation facilities will be inundated. The Corps, non-Federal sponsor and USBR will be involved in developing a management plan for Lake Clementine which takes into account the requirements and impacts of the selected flood control plan.

The selected plan includes 5385 acres along or near the South Fork American River for environmental mitigation. The land is generally heavily forested with some steep terrain. All of this land is privately owned. Some of the proposed mitigation site is currently used for grazing but rural residential development is encroaching in the area. At this time there are no structural improvements on these lands. Acquisition of this land will be more difficult if development is initiated before acquisition begins. Minor shifts in the location of the mitigation site are likely to occur.

Additional discussion of the proposed mitigation lands is included in Chapter VII of the main report and Chapters 7, 8 and 15 of the Environmental Impact Statement.

The selected plan includes approximately 52 acres of permanent road easements for the relocation of Highway 49 and Ponderosa Way. Most of the acreage needed for the relocations is within the limits of the take line for the detention basin where flowage easements will be acquired in addition to the road easements. The vast majority of the land is in Federal ownership and is currently managed by the California Department of Parks and Recreation, under an agreement with USBR, as part of the Auburn State Recreation Area. The 47.1 acres needed for the relocation of Highway 49, a State highway, are considered rural residential (14.1 acres) and forest (33 acres) lands. The value of the rural residential lands, which are unimproved to date, is influenced by nearby suburban development. The land needed for the Ponderosa Way relocation is along the North Fork of the American River. The land is zoned "W" for "Water Influenced District" and uses are restricted. The unpaved road and bridge are used primarily for access to recreation along the North Fork.

The value of all lands needed for the selected plan have been estimated at fair market value regardless of current ownership.

b. Natomas Area Real Estate. The area known as Natomas includes approximately 48,500 acres, over 80 percent of which are currently in agricultural use. Recent sales, however, reflect a speculative market in anticipation of residential, commercial, and light industrial development. The real estate requirements for the selected plan in the Natomas area, Arcade and Dry Creeks include fee lands; permanent levee, channel and flowage easements; and temporary easements for work areas and borrow material. The fee lands are needed for environmental mitigation and recreation trails.

NATOMAS AREA REAL ESTATE REQUIREMENTS

CONTRACT	FEE ACRES	FLOWAGE EASEMENTS	CHANNEL EASEMENTS	LEVEE EASEMENTS	TEMPORARY EASEMENTS
NATOMAS	280	279	20	54	241
RECREATION TRAILS	24				

The Natomas area is currently ringed by levees which are part of the Sacramento River Flood Control Project. The existing easements, which were acquired over several decades, grant a perpetual right-of-way and easement to construct, reconstruct, repair and maintain levees, including appurtenances such as embankments and ditches. In the absence of historical records to the contrary, it has been assumed that existing easements were at one time contributed by the non-Federal sponsor to a Federal flood control project. Therefore, only the additional lands needed for

levee modifications have been included in the cost estimate for the selected plan. Access for operation and maintenance is provided in existing easements.

On the east side of the Natomas area, the flood control features of the selected plan will require 16 acres of new levee easements along Arcade and Dry Creeks. Raising existing levees along the Natomas East Main Drainage Canal will require an additional 8.3 acres of levee easements. The borrow site for the levee construction contains 125 acres which will be acquired by temporary easement. A channel modification will require 19.5 acres of permanent channel easement. The detention basin will require 29.3 acres of levee easement around its perimeter, 279.2 acres of flowage easement, and 65 acres of temporary borrow easement within the basin itself. Fee title to 280 acres will be acquired for environmental mitigation.

The selected plan also includes recreation trails along the east side of Natomas. Although the trails will be on top of existing levees, current guidance requires that the non-Federal sponsor acquire fee title for the recreation features. Only 24 acres are needed, but the large number of parcels involved will result in substantial acquisition costs. It should be noted that there are separate sponsors for the flood control features and recreation features of the selected plan.

3. **Estates.** Either the non-Federal sponsor or the Corps will acquire the minimum interests in real estate which will support the construction and subsequent operation and maintenance of the project. For purposes of the baseline cost estimate, it has been assumed that the Corps standard estates will be used. However, it is probable that deviations from the standard estates ultimately will occur. For example, the operation and maintenance of the project will call for an adaptive management plan within the detention basin to ensure the reconstruction or rehabilitation of recreation trails which may be damaged by inundation. This management plan will likely require rights in addition to those rights contained in the standard flowage easement for occasional flooding. In addition, the typical estate language used by the non-Federal sponsor differs slightly from the language of the Corps estates. Prior to the start of negotiations, the Corps will review the non-Federal sponsor's estate language to ensure that (a) there will be no impediment to the construction, operation or maintenance of the project; and (b) the sponsor's estate language does not enhance the minimum rights needed such that an appreciable increase in fair market value may result.

Where rights will be acquired from Federal agencies, it is likely that the estate language will be modified to conform to the requirements of the agencies involved. For example, the BLM will have certain requirements with regard to the rights-of-way which will permit occasional flooding on lands over which that agency has

jurisdiction. Since the USBR has an authorized project at the upper American River site, that agency will not transfer lands for the dam and embankment to the Corps or non-Federal sponsor. Rights to construct the dam will likely be acquired through a joint use agreement.

With regard to the recreation trails, the non-Federal sponsor may seek approval of an easement estate rather than fee in order to avoid potential severance damages. In any event, deviations from the standard estates will be submitted to Corps Headquarters for approval prior to the start of negotiations.

4. PL 91-646 Relocations. Based on a cursory review of the potential relocations required by the selected plan, replacement housing appears to be available at this time for any displacees. Eight residential properties may require relocation in Natomas if the necessary levee modifications cannot be accomplished on the water side of the existing levee. The homes are modest and, since it would be premature to interview potential displacees at this time, it is not known whether the occupants are owners or tenants. If the residents have limited incomes, it is likely that replacement housing of last resort will be necessary. The estimated costs have been calculated accordingly.

5. Minerals. Inspections of the study areas in Natomas and the upper American River made in the process of completing land cost estimates revealed no commercial mineral operations. Records from the BLM indicate that during the summer 1991 there was one unpatented mining claim within the limits of the selected plan. Unpatented claims, which are often used for recreation, are believed to produce little in the way of mineral value to the holders. Regardless, the non-Federal sponsor will be required to subordinate any mining claims to the flood control purposes of the project.

6. Facility and Utility Relocations. The selected plan at the upper American River includes the relocation/replacement of two roads: Ponderosa Way and Highway 49. The real estate attorney's opinion of compensability of Highway 49 took into account a technical investigation which used as its criteria those areas of study mentioned in Federal cases dealing with the relocation of highways (see California v. United States, 169 F.2d 914 (C.A. 9, 1948), and County of Sarpy, Nebraska v. United States, 386 F.2d. 453, 181 Ct.Cl. 666). Those general areas of study include consideration of alternate traffic routes, safety, isolation of individual property owners, inconvenience, types of traffic, financial hardship and circuitry of travel to services and other areas. The results of the technical investigation support the conclusion that the pertinent section of Highway 49 affected by occasional flooding, as a consequence of the selected plan, should be relocated. Case precedent indicates that when the relocation of a public road has been determined to be "reasonably necessary", in

light of the above criteria, then compensation is due, and the amount of that compensation is the "reasonable cost" of furnishing a substitute facility that provides a degree of serviceability comparable to that provided by the existing facility. Since the investigation concludes that the pertinent section of the highway should be relocated, the relocation is, therefore, compensable. The amount of just compensation is the cost of reasonably relocating the highway.

The real estate cost estimates for the relocation/replacement of Ponderosa Way and Highway 49 are based on alignments provided by Engineering Division. It should be noted that the road easements are primarily within the boundaries of the detention basin and therefore overlap areas where flowage easements will be needed.

With regard to utility lines, further investigation will be made regarding the ownership of both the personal and real property rights in the utilities and their rights-of-way. Project effects will be analyzed on each utility to determine if they require an actual relocation. If relocation is determined to be necessary, then the owners are entitled to the reasonable cost of relocation under the circumstances, not necessarily what the owner indicates is the most desirable. No separate real estate costs have been established for the relocation of utility lines since the location of the relocation was not identified; such relocations are expected to occur within rights-of-way otherwise acquired for the selected plan.

7. **Sponsor's Ability to Acquire.** The non-Federal sponsors of the flood control project include The Reclamation Board of the State of California and the Sacramento Area Flood Control Agency (SAFCA). The Reclamation Board, through the Department of Water Resources (DWR), has the ability to acquire the necessary rights in real estate for the flood control project. DWR has the power of eminent domain pursuant to Water Code Sections 8590, et seq., and Code of Civil Procedures Sections 1230.010, et seq. DWR has an experienced right-of-way staff which has acquired lands for several flood control projects since implementation of the Water Resources Development Act of 1986. SAFCA also has the power of eminent domain through the SAFCA Joint Exercise of Powers Agreement adopted on September 26, 1989 and the SAFCA Act which was signed by the Governor on August 10, 1990. Since SAFCA does not have a right-of-way staff, it will contract for any right-of-way work it may undertake.

The non-Federal sponsors of the recreation features of the project are the City and County of Sacramento. Both entities have the power of eminent domain pursuant to the Code of Civil Procedure commencing with Section 1230.010. The City has four experienced right-of-way agents and hires consultants as necessary. The County has 20 experienced right-of-way agents. Although neither entity has participated in a Corps project, the right-of-way staffs have

been apprised of the procedures and requirements and no problems are expected.

The non-Federal sponsors prepared their respective estimates of acquisition costs and schedules based on their knowledge of project requirements and anticipated staffing and resource levels.

8. **Baseline Cost Estimate.** The baseline cost estimate by contract follows. The Appraisal Branch of the Sacramento District Real Estate Division prepared the gross appraisal upon which the land cost estimates are based. Costs are estimated at October 1991 price levels. All lands, regardless of ownership, have been estimated at fair market value. The environmental mitigation sites were provided by Environmental Resources Branch of the Planning Division as representative of sites which ultimately will be selected. The differences between State and Federal appraisal rules have been considered and are not expected to have any appreciable impact on the estimated real estate costs.

BASELINE COST ESTIMATE FOR REAL ESTATE				
CONTRACT	**NON-FEDERAL**	**FEDERAL**	**LANDS* (LERRDs)**	**TOTAL**
Dam Foundation and Mitigation	1,376,500	382,000	44,884,000	**46,642,500**
Embankment and Detention Basin	1,058,900	277,000	12,539,000	**13,874,900**
Relocations	214,400	154,900	778,500	**1,147,800**
Natomas	3,469,200	316,000	10,268,300	**14,053,500**
Recreation Trails	4,494,800	357,000	1,922,000	**6,773,800**

*Includes lands, damages, contingencies and PL91-646 relocations.

The non-Federal sponsors' estimated acquisition costs were prepared by the respective non-Federal sponsors. The Federal costs of negotiating agreements on Federal lands, monitoring the acquisitions, certifying for construction and crediting the sponsor were estimated by the Real Estate Division, taking into consideration that its involvement with the project will continue for several years. Estimates vary per contract based on the number of parcels and owners involved and the anticipated difficulty of the negotiations. The greater number of parcels and owners affected by the Natomas and recreation trail contracts results in

higher estimated acquisition costs.

9. **Hazardous and Toxic Waste.** No hazardous or toxic waste (HTW) sites were noted by appraisers in the process of completing cost estimates for this investigation. A literature review was conducted to determine the extent of known sites within the project area. This review included Federal, State, and local agency lists and data bases of HTW sites. The literature review indicated that several HTW sites exist within the study area. This finding is not unusual because of the intensive industrial development in parts of the study area. No HTW sites are located at the site of the proposed flood control dam or in any areas of proposed levee construction or modification.

In addition to real estate appraisers, other Corps personnel conducted a preliminary field review to determine whether any HTW sites exist in any areas where project construction or construction-related activity would occur. It appears from the initial field survey that no such sites exist. However, a field reconnaissance and review of aerial photos of the construction area will be made during the design phase of the project to determine whether there are any unlisted HTW sites in any project construction areas or rights-of-way. Results of this work and an updated literature survey will be formally coordinated with the non-Federal sponsors and the appropriate Federal, State and local agencies. In addition, the corps will develop a contingency plan identifying a responsible agency and outlining a course of action in the event that HTW sites are uncovered during construction.

10. **Maps.** Plates 1 through 4 show the limits of the real estate requirements for the selected plan.

11. **Acquisition Schedule.** Detailed acquisition schedules begin on the next page. Excepting the recreation features of the project, the non-Federal sponsors have scheduled preliminary acquisition activities prior to the signing of the Local Cooperation Agreement (LCA). The non-Federal sponsors are aware of the risks of initiating the acquisition process before the LCA is signed.

REAL ESTATE MILESTONES				
DAM FOUNDATION*	COE START	COE FINISH	NFS START	NFS FINISH
Receipt of final drawings from Engineering/PM	11/93	11/93		
Execution of LCA	11/94			
Formal transmittal of final ROW drawings & instructions to acquire LERRD	11/93	11/93	11/94	11/94
Conduct landowner meetings	Land owned by USBR			
Prepare/review mapping and legal descriptions	11/93	2/94	11/94	2/95
Obtain/review title evidence	11/93	3/94	11/94	2/95
Obtain/review tract appraisals	N/A		2/95	5/95
Conduct negotiations	11/93	3/94	5/95	7/95
Perform closings		5/94	7/95	7/95
Prepare/review condemnations	N/A			
Perform condemnations	N/A			
Obtain possession		5/94		7/95
Complete/review PL 91-646 benefit assistance	N/A			
Conduct/review facility and utility relocations	N/A			
Certify all necessary LERRD is available for construction	5/94 8/95	5/94 8/95	8/95	8/95
Prepare and submit credit requests			10/95	12/95
Review/approve or deny credit requests	1/96	6/96		
Establish value for creditable LERRD in F&A cost accounting system	7/96	9/96		

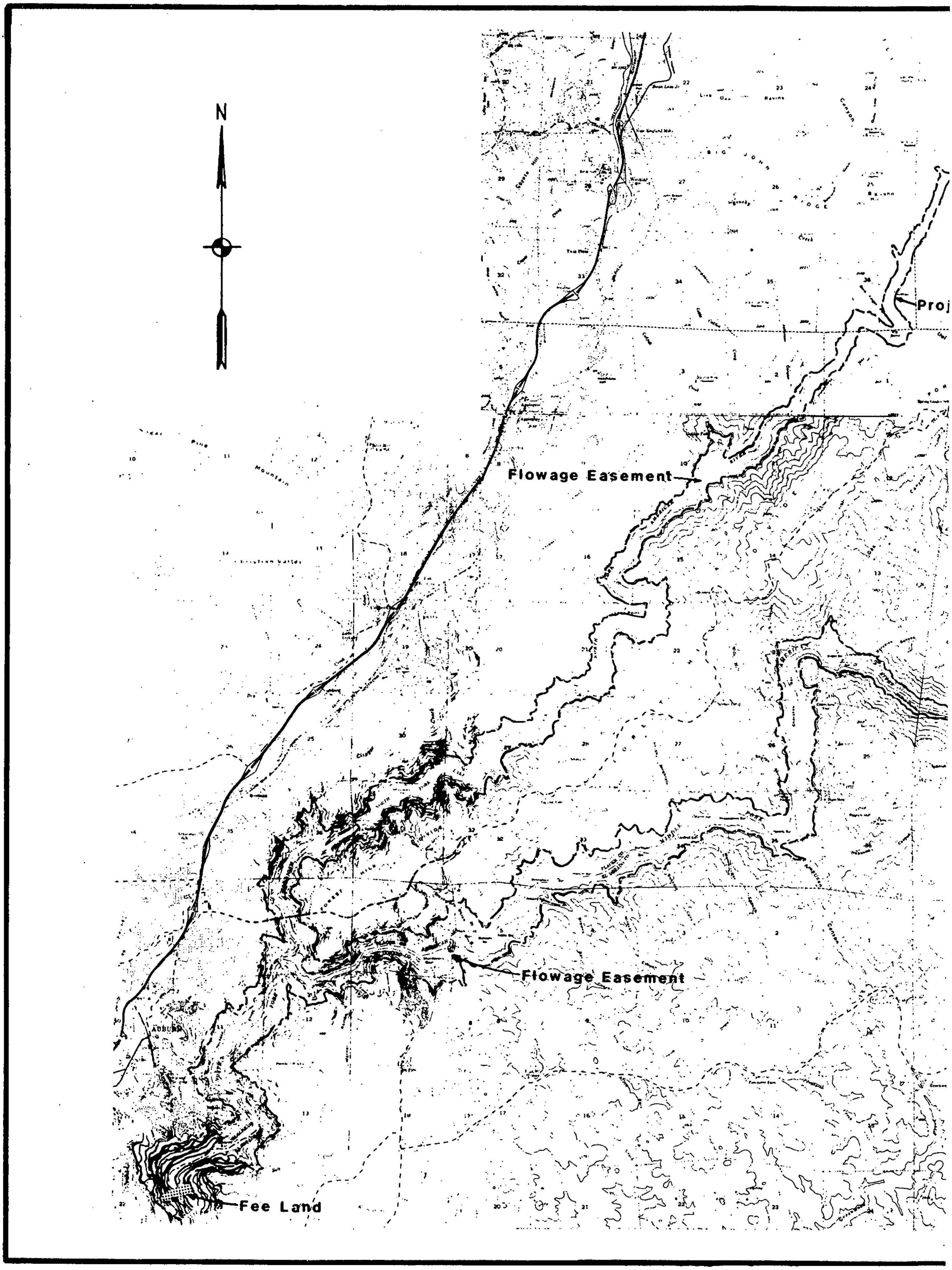
* Lands are owned by USBR. The Corps will negotiate a joint use agreement with USBR for the lands. The non-Federal sponsor's schedule applies to temporary easements and borrow material needed for the foundation contract.

REAL ESTATE MILESTONES				
DETENTION BASIN AND ROADS	COE START	COE FINISH	NFS START	NFS FINISH
Receipt of final drawings from Engineering/PM		11/94		
Execution of LCA	11/94			
Formal transmittal of final ROW drawings & instruction to acquire LERRD		11/94		
Conduct landowner meetings			5/95	8/95
Prepare/review mapping and legal descriptions			2/95	8/95
Obtain/review title evidence			2/95	10/95
Obtain/review tract appraisals			9/95	6/96
Conduct negotiations			6/96	6/97
Perform closings			9/96	9/97
Prepare/review condemnations			9/96	9/97
Perform condemnations			11/96	10/97
Obtain possession			2/97	1/98
Complete/review PL 91-646 benefit assistance			N/A	
Conduct/review facility and utility relocations			9/95	10/97
Certify all necessary LERRD is available for construction	1/98	5/98		1/98
Prepare and submit credit requests			2/98	6/98
Review/approve or deny credit requests	6/98	10/98		
Establish value for creditable LERRD in F&A accounting system	10/98	1/99		

REAL ESTATE MILESTONES				
UPPER AMERICAN ENVIRONMENTAL MITIGATION	COE START	COE FINISH	NFS START	NFS FINISH
Receipt of final drawings from Engineering/PM		1/96		
Execution of LCA	11/94			
Formal transmittal of final ROW drawings & instructions to acquire LERRD		1/96		
Conduct landowner meetings			1/96	3/96
Prepare/review mapping and legal descriptions			11/95	5/96
Obtain/review title evidence			11/95	5/96
Obtain/review tract appraisals			2/96	6/96
Conduct negotiations			6/96	11/96
Perform closings			9/96	2/97
Prepare/review condemnations			1/97	3/97
Perform condemnations			3/97	5/97
Obtain possession			5/97	7/97
Complete/review PL 91-646 benefit assistance			N/A	
Conduct/review facility and utility relocations			5/96	6/97
Certify all necessary LERRD is available for construction	8/97	12/97	8/97	9/97
Prepare and submit credit requests			8/97	12/97
Review/approve or deny credit requests	12/97	4/98		
Establish value for creditable LERRD in F&A cost accounting system	4/98	7/98		

REAL ESTATE MILESTONES				
NATOMAS LEVEES AND MITIGATION CONTRACT	COE START	COE FINISH	NFS START	NFS FINISH
Receipt of final drawings from Engineering/PM		11/94		
Execution of LCA	11/94			
Formal transmittal of final ROW drawings & instruction to acquire LERRD		11/94		
Conduct landowner meetings			10/94	1/95
Prepare/review mapping & legal descriptions			11/94	2/95
Obtain/review title evidence			11/94	2/95
Obtain/review tract appraisals			3/95	10/95
Conduct negotiations			12/94	8/96
Perform closings			2/95	11/96
Prepare/review condemnations			3/95	7/96
Perform condemnations			5/95	8/96
Obtain possession			8/95	11/96
Complete/review PL 91-646 benefit assistance			11/95	10/96
Conduct/review facility and utility relocations			2/95	2/96
Certify all necessary LERRD is available for construction	12/96	3/97	11/96	11/96
Prepare and submit credit requests			11/96	1/97
Review/approve or deny credit requests	1/97	6/97		
Establish value for creditable LERRD in F&A cost accounting system	6/97	8/97		

REAL ESTATE MILESTONES				
NATOMAS RECREATION TRAILS	COE START	COE FINISH	NFS START	NFS FINISH
Receipt of final drawings from Engineering/PM		10/95		
Execution of LCA	10/95			
Formal transmittal of final ROW drawings & instruction to acquire LERRD		10/95		
Conduct landowner meetings			10/95	1/96
Prepare/review mapping and legal descriptions			10/95	11/96
Obtain/review title evidence			10/95	11/96
Obtain/review tract appraisals			7/96	7/97
Conduct negotiations			1/97	1/98
Perform closings			3/97	3/98
Prepare/review condemnations			3/97	5/98
Perform condemnations			6/97	6/98
Obtain possession			9/97	12/98
Complete/review PL 91-646 benefit assistance			N/A	
Conduct/review facility and utility relocations			N/A	
Certify all necessary LERRD is available for construction	12/98	2/99		12/98
Prepare and submit credit requests			2/99	12/99
Review/approve or deny credit requests	2/99	4/00		
Establish value for creditable LERRD in F&A cost accounting system	2/00	7/00		


N
Proj
Flowage Easement
Flowage Easement
Fee Land

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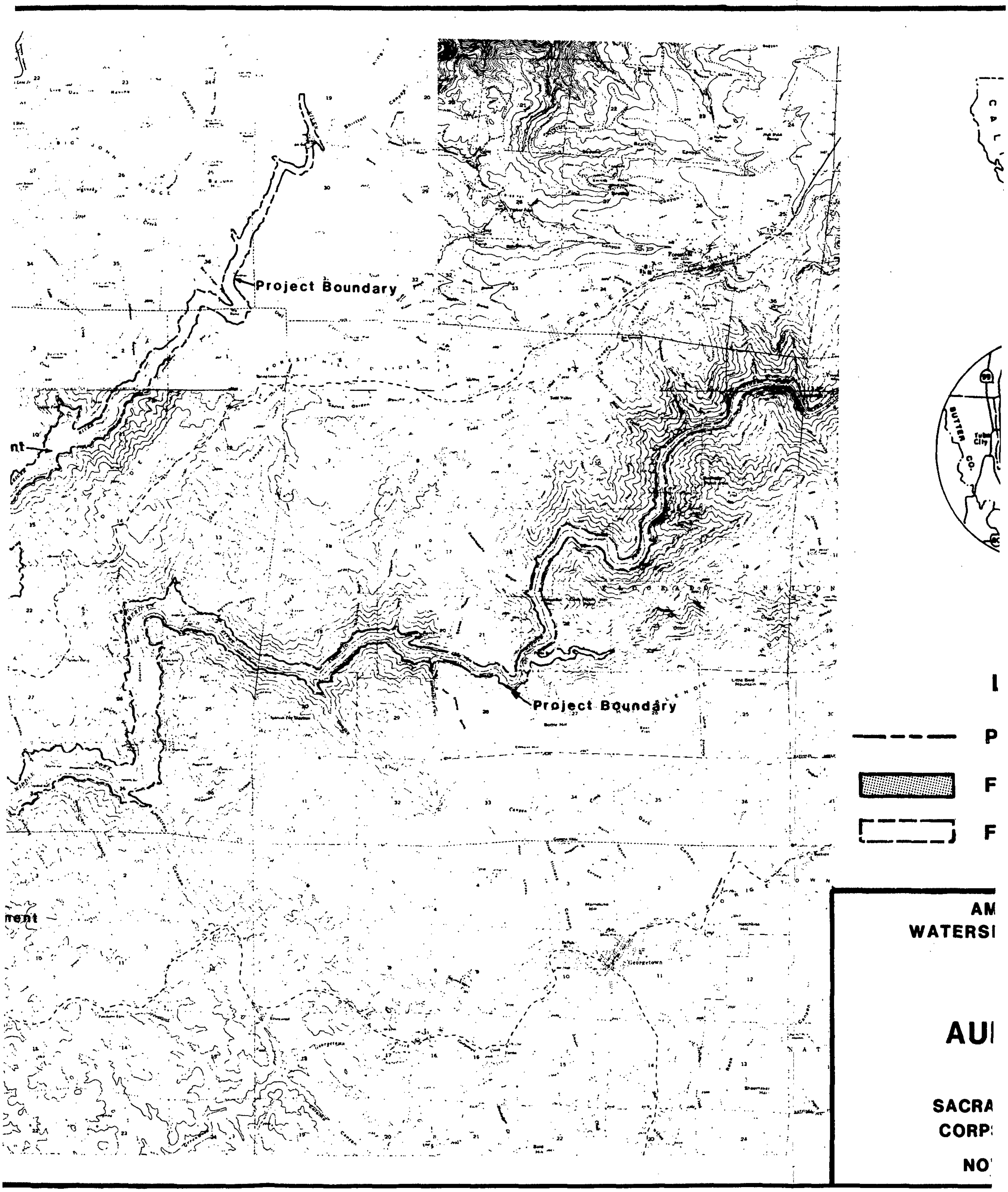
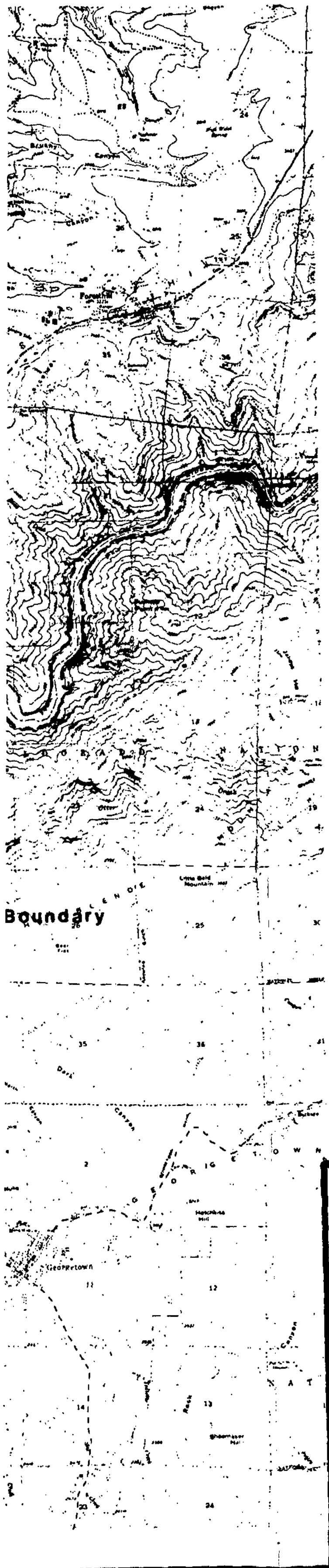
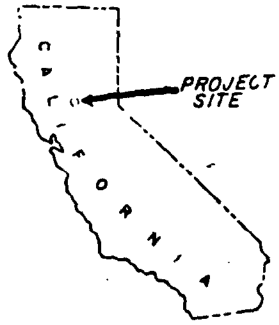
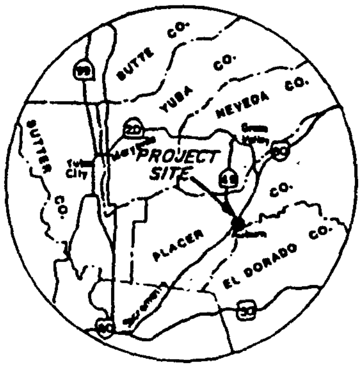

Project Boundary
Project Boundary
Georgetown
AM
WATERSI
AUI
SACRA
CORP
NO





STATE INDEX



VICINITY MAP

LEGEND

Project Boundary

Fee Land

Flowage Easement

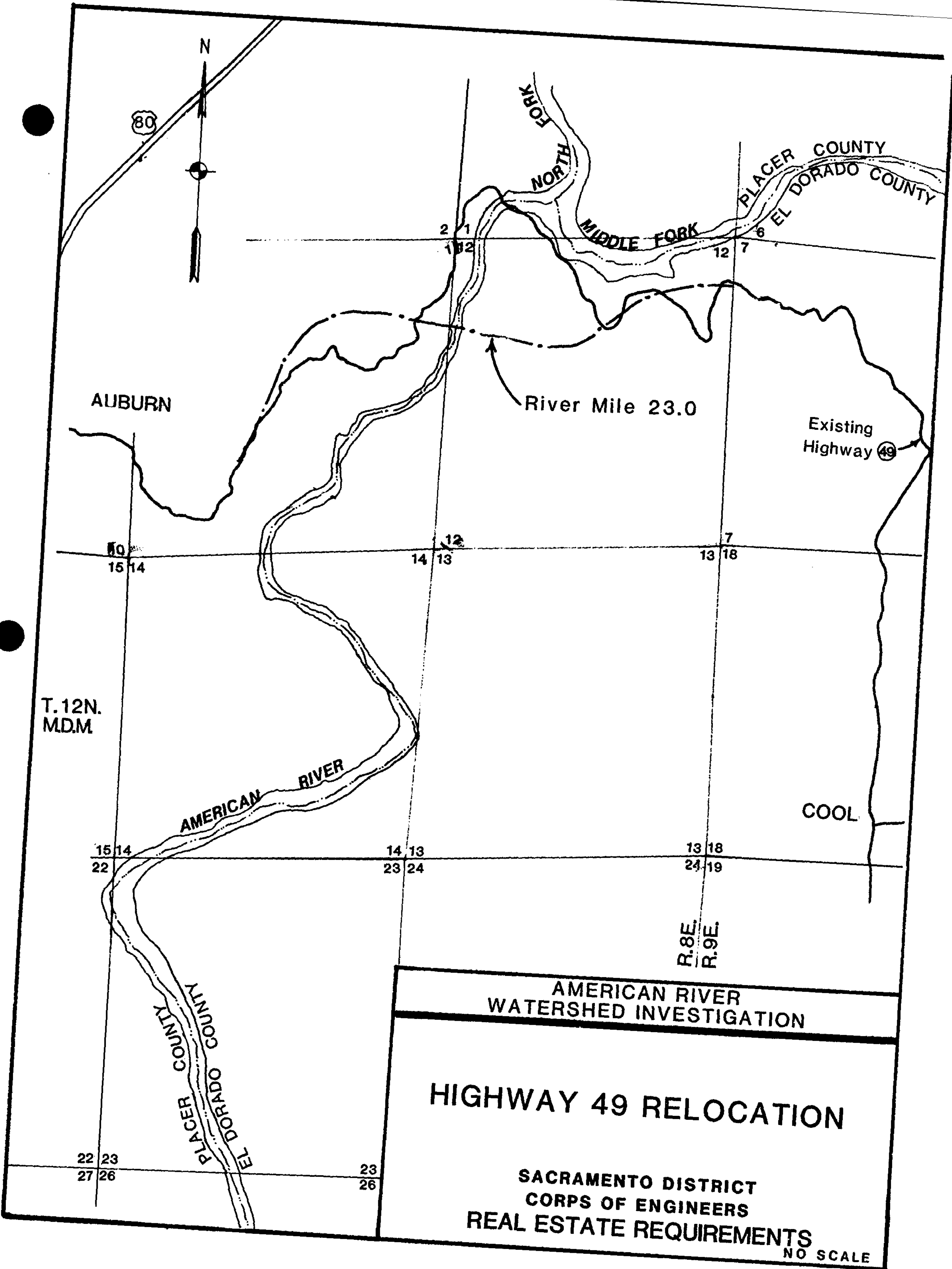
AMERICAN RIVER
WATERSHED INVESTIGATION
CALIFORNIA

AUBURN DAM

SACRAMENTO DISTRICT
CORPS OF ENGINEERS

NOVEMBER 1991 NO SCALE

3 **PLATE 1**



AMERICAN RIVER
WATERSHED INVESTIGATION

HIGHWAY 49 RELOCATION

SACRAMENTO DISTRICT
CORPS OF ENGINEERS
REAL ESTATE REQUIREMENTS
NO SCALE

PLATE 2

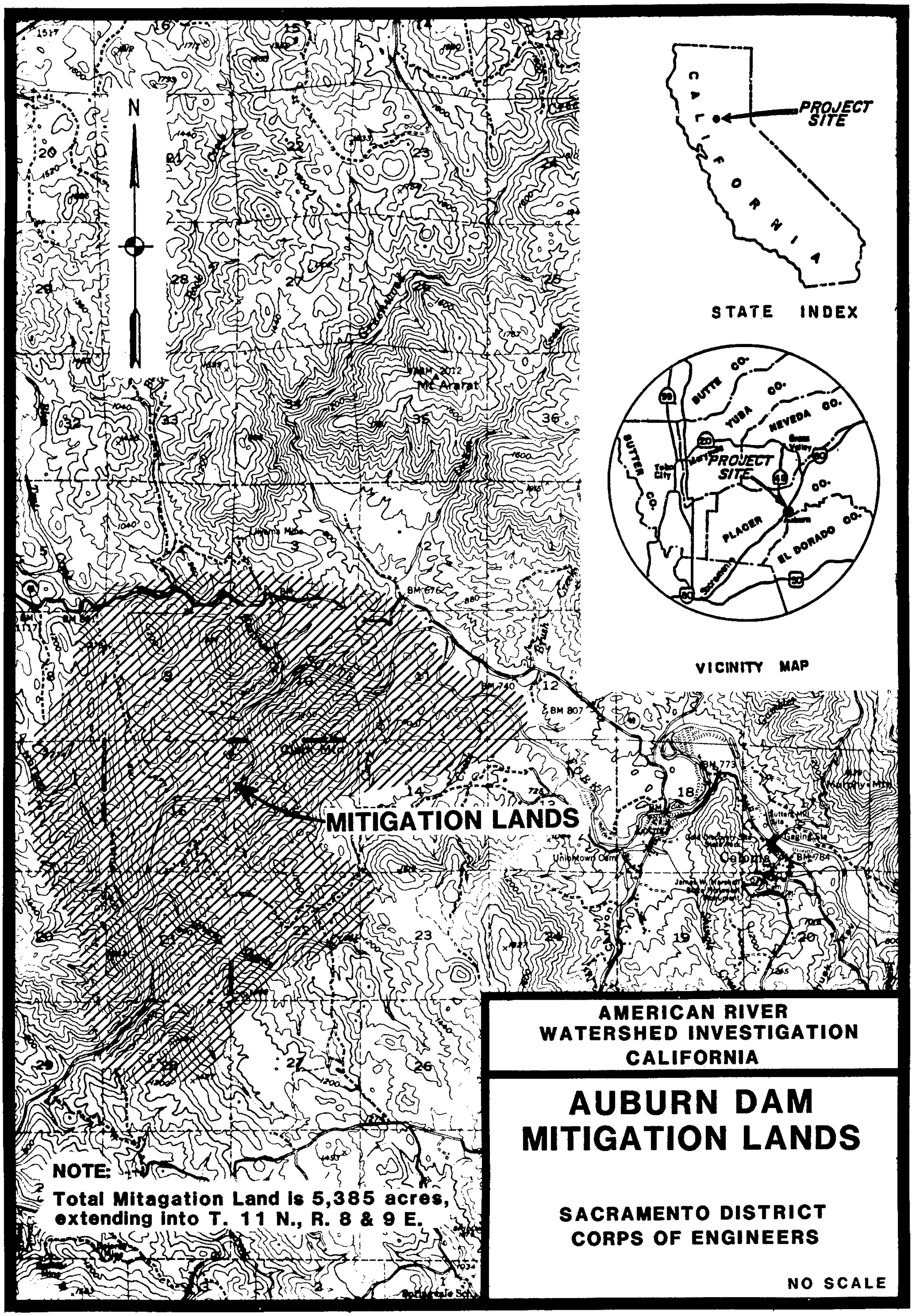
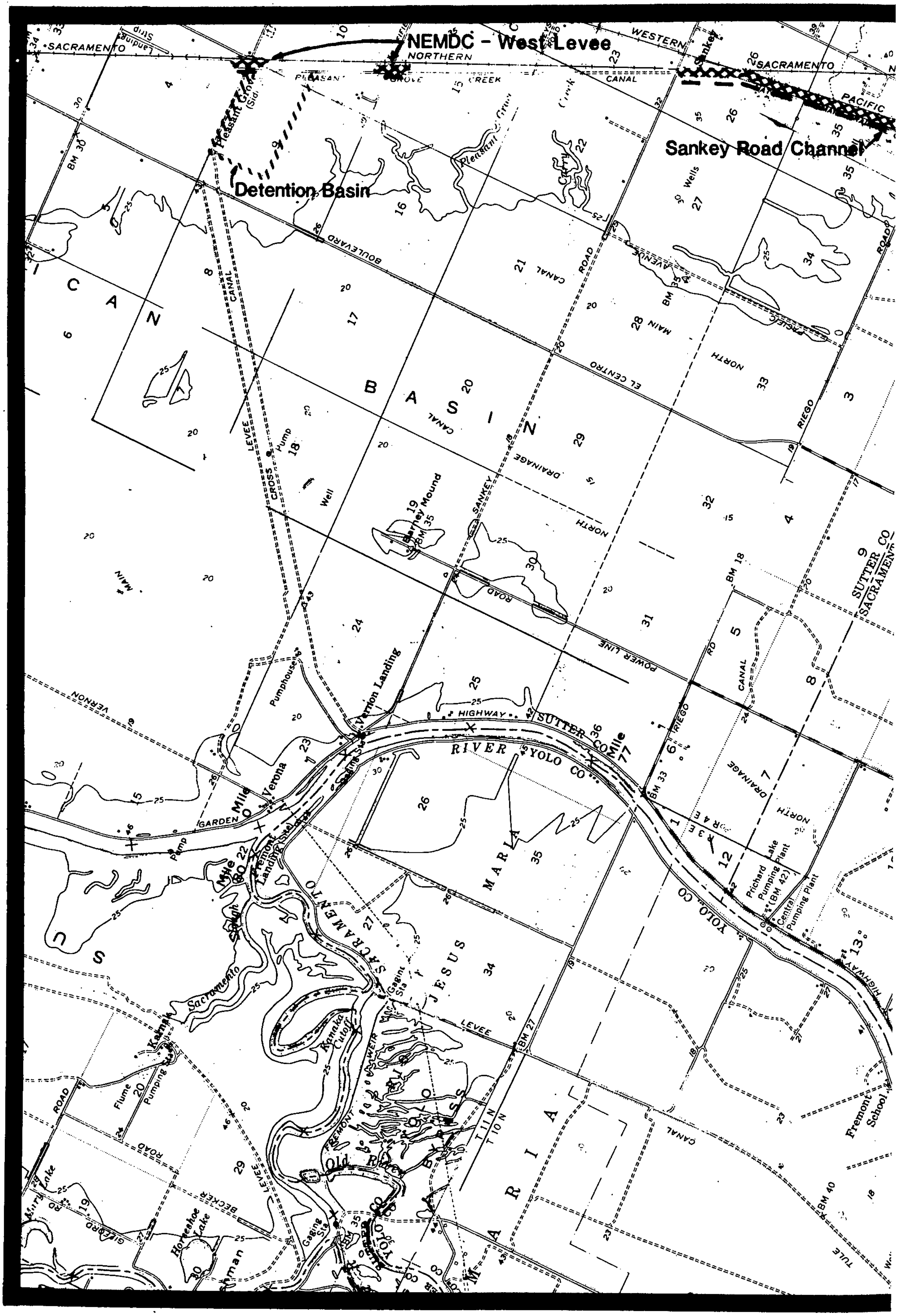

PROJECT SITE
CALIFORNIA
STATE INDEX
BUTTE CO.
YUBA CO.
NEVADA CO.
SUTTER CO.
PROJECT SITE
PLACER CO.
EL DORADO CO.
VICINITY MAP
N
Mt Ararat
MITIGATION LANDS
Uniontown Cem
NOTE:
Total Mitagation Land is 5,385 acres,
extending into T. 11 N., R. 8 & 9 E.
AMERICAN RIVER
WATERSHED INVESTIGATION
CALIFORNIA
AUBURN DAM
MITIGATION LANDS
SACRAMENTO DISTRICT
CORPS OF ENGINEERS
NO SCALE

PLATE 3


NEMDC - West Levee
Sankey Road Channel
Detention Basin
SACRAMENTO
NORTHERN
WESTERN
PACIFIC
PLEASANT GROVE CREEK CANAL
BOULEVARD
CROSS CANAL
LEVEE
Pump
Well
Barney Mound
SANKEY ROAD
EL CENTRO
NORTH
MAIN
DRAINAGE CANAL
POWER LINE
RIEGO ROAD
SUTTER CO
SACRAMENTO
VERNON
Pumphouse
Vernon Landing
HIGHWAY
SUTTER CO
YOLO CO
RIVER
Mile 77
Verona
Mile 80
GARDEN
Fremont Landing
Prichard Lake Pumping Plant
Central Pumping Plant
HIGHWAY
Fremont School
Kamaka Cutoff
Sacramento
Karnak
Flume
Pumping
Old River
Horseshoe Lake
GIFFORD RD
BECKER ROAD
CANAL
TULE
SACRAMENTO
JESUS
MARIA
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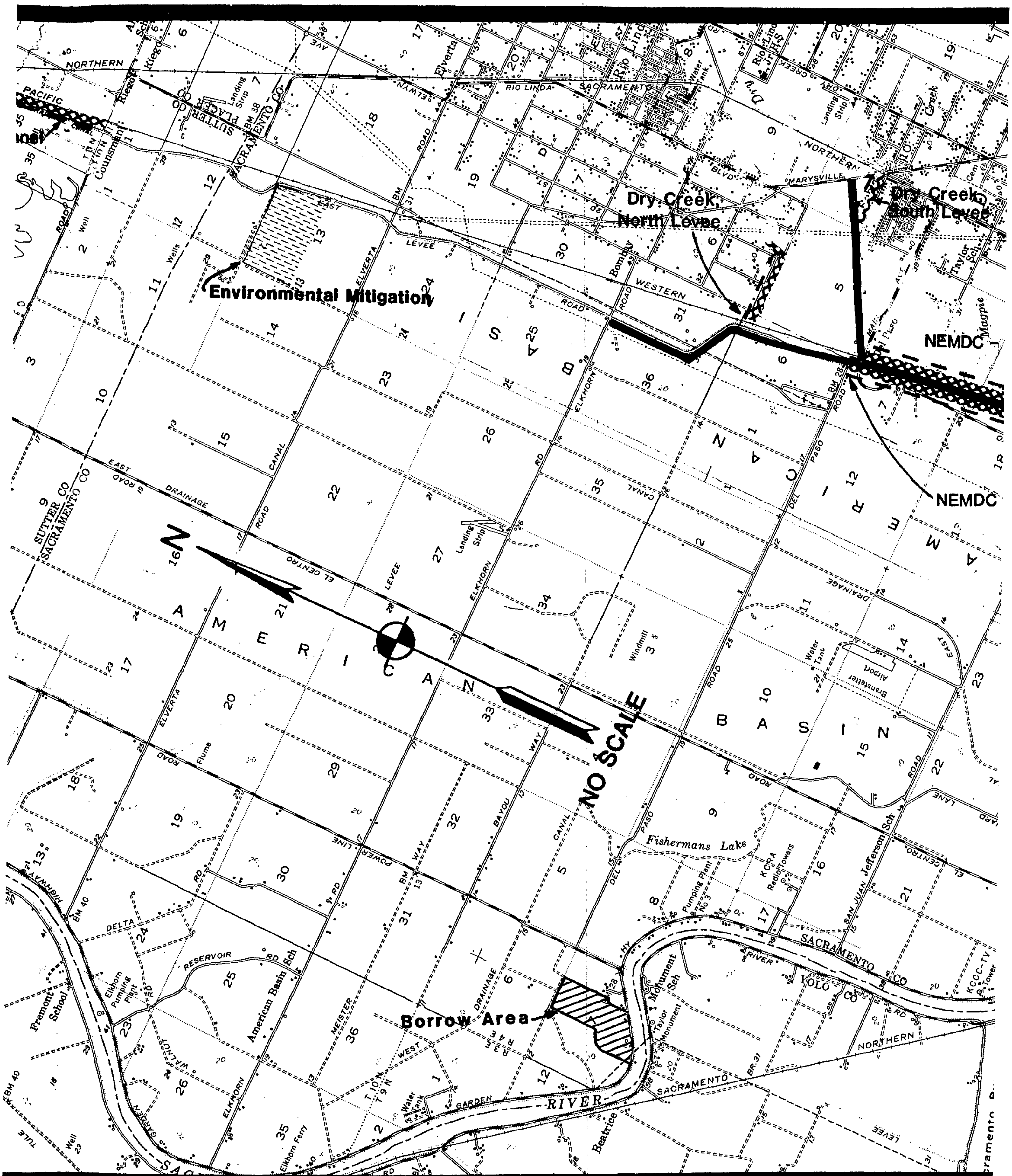
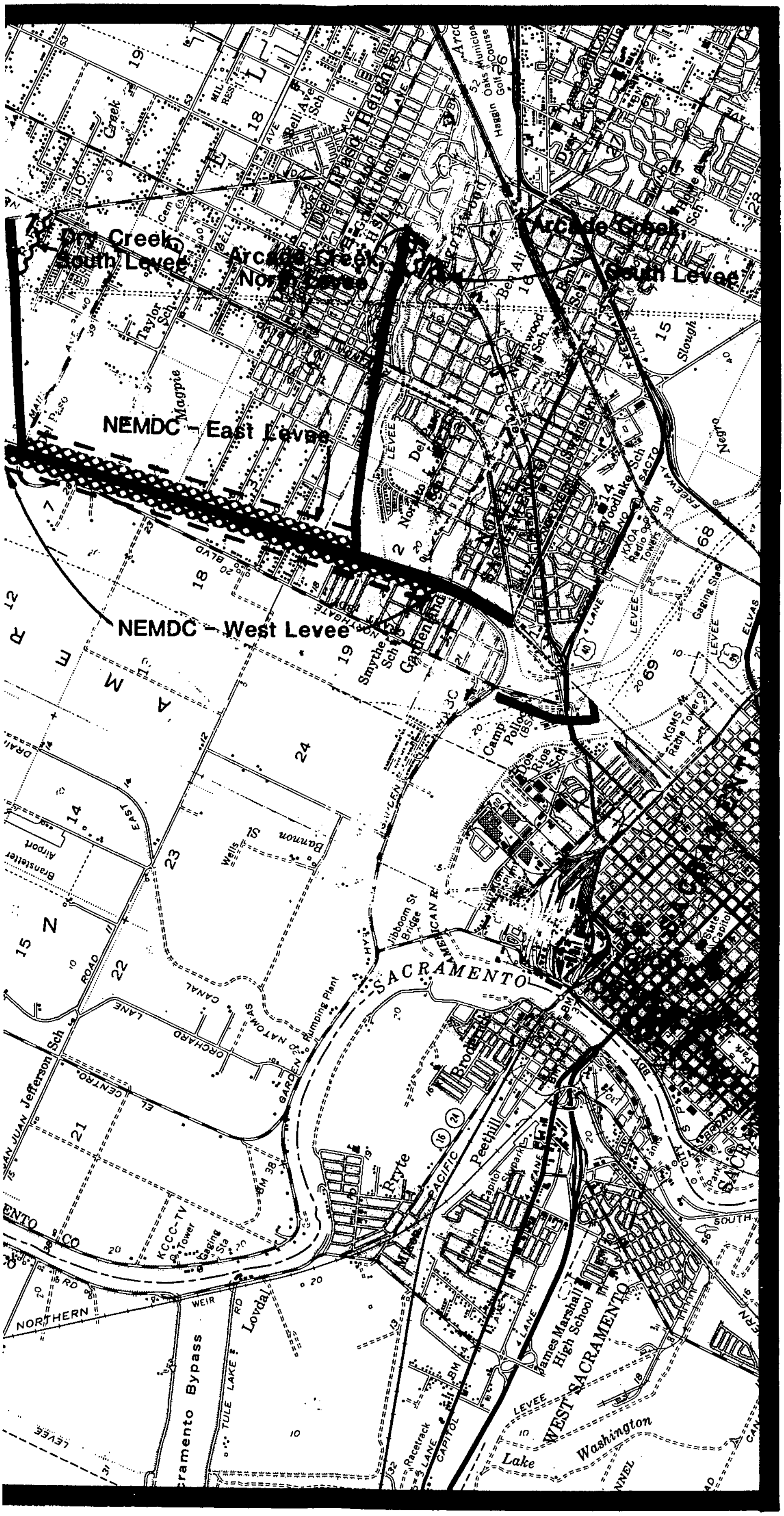
FREMONT WEIR
BM 27
BM 33
BM 40
BM 18
BM 30


Environmental Mitigation
Dry Creek North Levee
Dry Creek South Levee
NEMDC
NEMDC
AMERICAN BASIN
NO SCALE
Borrow Area
Fishermans Lake
SACRAMENTO RIVER
SUTTER CO
SACRAMENTO CO
YOLO CO
Rio Linda
Elverta
American Basin Sch
Fremont School



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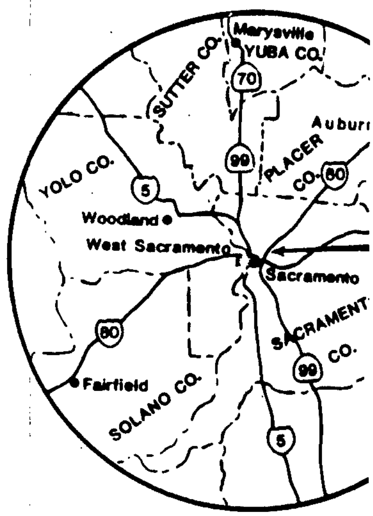

VICINITY MAP

LEGEND

- Levee Easemenl
- Temporary Cons
- Flowage Easeme
- Channel Easeme
- Recreation Trail
- Detention Basin
- MITIGATION LANI

AMERICAN RIVER WATERS

NATOM

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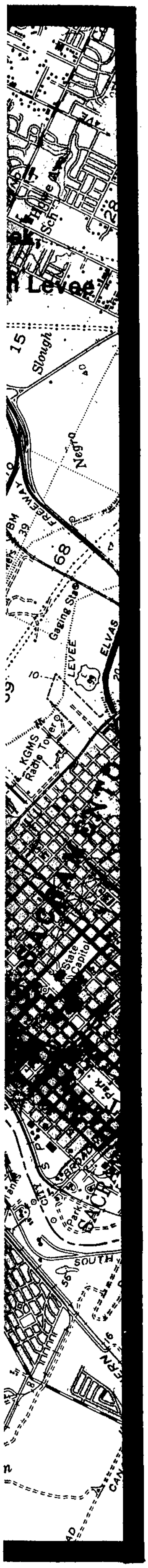
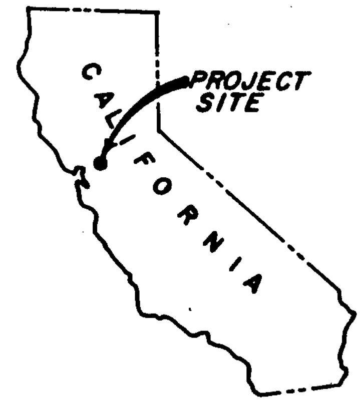
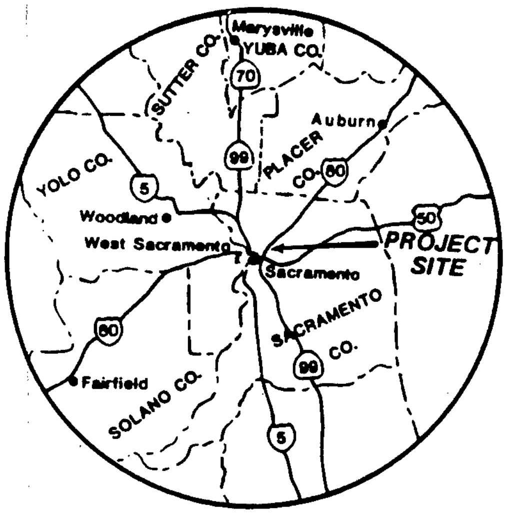




STATE INDEX



VICINITY MAP

LEGEND

- Levee Easement
- Temporary Construction Easement
- Flowage Easement
- Channel Easement
- Recreation Trails
- Detention Basin
- MITIGATION LANDS

AMERICAN RIVER WATERSHED INVESTIGATION

NATOMAS

REAL ESTATE REQUIREMENTS

SACRAMENTO DISTRICT
CORPS OF ENGINEERS

NO SCALE

PLATE 4

American River Watershed Investigation, California

APPENDIX P

Endangered Species

APPENDIX P

ENDANGERED SPECIES

Table of Contents

APPENDIX P
ENDANGERED SPECIES

Attachment 1 - Pertinent Correspondence

Date	Subject
12/02/1988	Letter from USFWS-Ecological Services to California Department of Fish and Game (CDFG) requesting information on 13 listed and sensitive species.
01/24/1989	Letter to USFWS-Ecological Services from CDFG adding 6 additional species to USFWS list.
03/07/1989	Letter from USFWS-Ecological Services to U.S. Army Corps of Engineers (COE) identifying 19 species of concern.
04/24/1989	COE letter to USFWS-Endangered Species Office requesting list of sensitive species.
05/02/1989	USFWS-Endangered Species Office letter to COE providing Federal list of listed and candidate species.
05/02/1989	California Department of Water Resources (DWR) letter to CDFG initiating endangered species consultation process.
07/02/1990	CDFG letter to DWR/Reclamation Board listing 3 species of concern.
11/26/1990	Draft Biological Opinion from CDFG to DWR/Reclamation Board.

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Division of Ecological Services
2800 Cottage Way, Rm. E-1803
Sacramento, California 95825

December 2, 1988

Mr. Jim Messersmith
Regional Manager, Region II
California Department of Fish and Game
1701 Nimbus Road
Rancho Cordova, California 95670

Subject: Corps of Engineers - American River Watershed Study, State Listed and Sensitive Species

Dear Mr. Messersmith:

The Corps of Engineers is conducting a study of potential flood control measures for the American River watershed, and portions of the Sacramento River and the Natomas area in the vicinity of the City of Sacramento (see Figure). Specific alternatives being considered by the Corps for controlling flooding in the study area are described in the Reconnaissance Report for the American River Watershed Investigation, California, U.S. Army Corps of Engineers, Sacramento District, January 1988. The State of California is the non-Federal sponsor for the feasibility studies and will share equally, with the Federal government, the costs of the studies.

To aid in the formulation and evaluation of flood control alternatives, the Fish and Wildlife Service is conducting studies of fish and wildlife resources within the study area pursuant to the Fish and Wildlife Coordination Act. We are aware that the study area includes significant habitat for fish and wildlife resources and also supports populations of species listed as endangered, threatened, rare, and sensitive by the State and Federal governments. To assure adequate consideration of all fish and wildlife resources within the study area, we have compiled a list of species designated by the State and/or Federal governments as endangered, threatened, and rare which likely occur within the study area (Table 1). Because the California Endangered Species Act places certain obligations on State agencies for actions affecting State-listed species, we would appreciate your review of our preliminary list to determine its completeness. We would also like to know your specific concerns regarding the project's potential impacts to these species and what requirements the California Endangered Species Act places on any participating agencies.

Any questions you have regarding this request should be directed to Monty Knudsen of my staff at (916) 978-4613. Thank you for your assistance.

Sincerely,

James W. Carson

for James J. McKevitt
Field Supervisor

Attachments

cc: ARD (FWE) FWS, Portland, OR
Col. Jack A. Le Cuyer, Dist. Eng.,
Corps of Engineers, Sacramento, CA
Dir., CDFG, Sacramento, CA
Dr. Larry Eng, CDFG, Environmental
Services, Sacramento

Table State and Federally Listed Endangered, Threatened, Rare and Federal Candidate Species Found Within the American River Flood Control Study Area.

Listed Species

Insects

Valley elderberry longhorn beetle, Desmocerus californicus dimorphus FT

Reptiles

Giant garter snake, Thamnophis couchi gigas ST, FC2

Birds

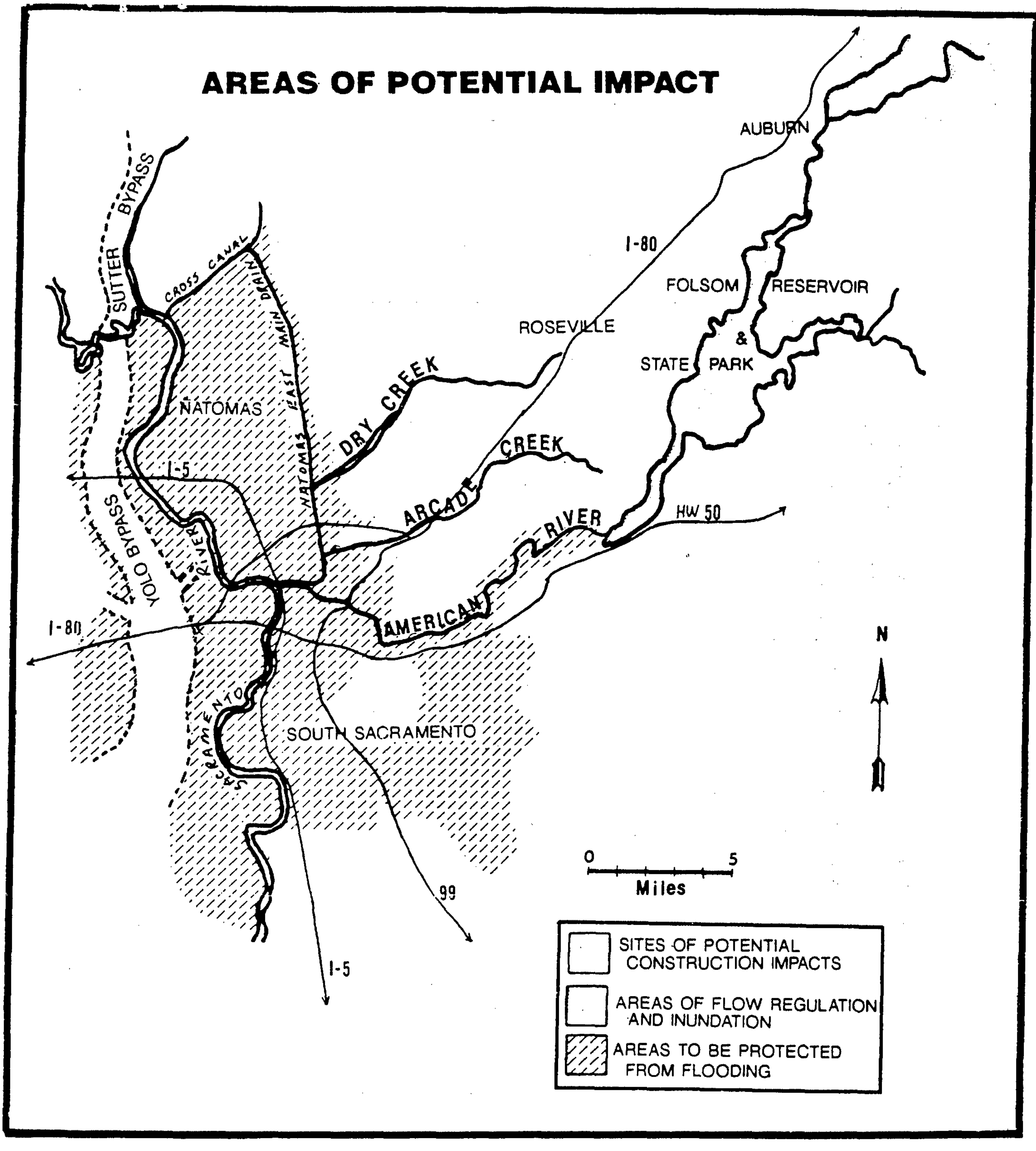
Bald eagle, Haliaeetus leucocephala SE, FT
Swainson's hawk, Buteo swainsoni ST, FC2
Western yellow-billed cuckoo, Coccyzus americanus occidentalis ST, FC2

Plants

Pleasant Valley mariposa, Calochortus clavatus var. avius FC1
Stebbin's/El Dorado morning-glory, Calystegia stebbinsii SE, FC2
hispid bird's-beak, Cordylanthus mollis subsp. hispidus FC2
El Dorado bedstraw, Galium californicum subsp. sierrae SR, FC2
Bogg's Lake hedge-hyssop, Gratiola heterosepala SE, FC2
Greene's legenere, Legenere limosa FC2
saw-toothed lewisia, Lewisia serrata, FC2
Valley sagittaria, Sagittaria sanfordii FC2

SE = State-listed endangered
ST = State-listed threatened
SR = State-listed rare

FE = Federally-listed endangered
FT = Federally-listed threatened
FC1 or 2 = Federal candidate, category 1 or 2


AREAS OF POTENTIAL IMPACT
AUBURN
I-80
FOLSOM
RESERVOIR
&
STATE
PARK
ROSEVILLE
SUTTER BYPASS
CROSS CANAL
EAST MAIN DRAIN
NATOMAS
NATOMAS
DRY CREEK
ARCADE CREEK
I-5
YOLO BYPASS
RIVER
AMERICAN RIVER
HW 50
I-80
SACRAMENTO
SOUTH SACRAMENTO
N
0
5
Miles
99
I-5
SITES OF POTENTIAL CONSTRUCTION IMPACTS
AREAS OF FLOW REGULATION AND INUNDATION
AREAS TO BE PROTECTED FROM FLOODING

File: CESAC - Amer. River Watershed

STATE OF CALIFORNIA—THE RESOURCES AGENCY GEORGE DEUKMEJIAN, Governor

DEPARTMENT OF FISH AND GAME
REGION 2
1701 NIMBUS ROAD, SUITE A
RANCHO CORDOVA, CALIFORNIA 95670
(916) 355-7020

JAN 24 1989

Mr. James J. McKevitt, Field Supervisor
U. S. Fish and Wildlife Service
2800 Cottage Way, Room E-1803
Sacramento, CA 95825

Dear Mr. McKevitt:

The Department of Fish and Game (DFG) has received your December 2, 1988 letter regarding the Corps of Engineers' American River Watershed Study in Placer, Eldorado, Sacramento, and Yolo Counties. Your letter requests our review of your tentative list of sensitive plants and animals that may be impacted by the Corps Project and inquires about the California Endangered Species Act (CESA).

In addition to those plants and animals in your letter, our files show that the following sensitive plants may be found within the study area:

1. Laynes butterweed (Senecio layneae), State listed Rare (SR) and Federal candidate, category (FC) 2.

2. Pine hill flannel bush (Fremontodendron decumbens), SR,FC2.

3. El Dorado County mule ear (Wyethia reticulata), FC2.

4. Pine Hill ceanothus (Ceanothus roderickii), SR, FC2.

5. Red Hill soaproot (Chlorogalum grandiflorum), FC2.

6. Bisbee Peak rush-rose (Helianthemum suffrutescens), FC2.

The DFG recommends the project study area be surveyed by a qualified botanist and biologist to determine: 1) if any of the sensitive plants and animals on our combined lists are present within the project site, 2) potential project impacts upon them, and 3) mitigation for any adverse impacts upon these sensitive species. If any State-listed threatened or endangered species are found, CESA requires the State lead agency to request either an informal (preliminary review) or formal consultation with the DFG.

FISH AND WILDLIFE SERVICE
RECEIVED
JAN 25 1989
SACRAMENTO

As you are aware, the State Environmental Quality Act requires the State lead agency to identify and mitigate the project's impact upon not only these sensitive species, but its impact upon all the fish and wildlife resources.

If the DFG can be of further assistance, please contact Jerry Mensch, Environmental Services Supervisor, telephone (916) 355-7030.

James D. Messersmith
Regional Manager

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Division of Ecological Services
2800 Cottage Way, Room E-1803
Sacramento, California 95825

March 7, 1989

Colonel Jack A. LeCuyer
District Engineer
Sacramento District Corps of Engineers
650 Capitol Mall
Sacramento, California 95814-4794

Dear Colonel LeCuyer:

This letter responds to your request for us to coordinate with the California Department of Fish and Game (Department) and obtain information about the California Endangered Species Act as described in the October 1988, revised scope of work for the American River Watershed Study. On December 2, 1988, we requested from the Department a list of those species in the American River Watershed Study area that are listed as endangered, threatened or rare or otherwise of concern to the Department (letter attached).

The Department's response dated January 24, 1989 (copy enclosed), provides a listing of six plants (in addition to those listed in our letter of December 2, 1988) that may be impacted by the project. The Department suggested that surveys of the study area be conducted to determine: 1) if any of the 19 identified species occur in the study area, 2) what, if any, impacts may occur to these species as a consequence of the project; and 3) for those species that may be adversely affected, identify measures to mitigate the impacts.

With regard to the requirements of the California Endangered Species Act (CESA), the Department letter indicates that a State lead agency is required to request formal consultation with the Department when any State-listed species occur in the project area and may be affected by the project. This requirement applies to all projects subject to the California Environmental Quality Act (CEQA). A more detailed discussion of the requirements of this State Act is provided in Cummings and Nicola 1986 (copy attached).

Based on the above discussion, it appears that the State Reclamation Board or the Department of Water Resources, whichever acts as State lead agency, will be required to: 1) complete field surveys for the identified species and assess the likely impacts the project will have on them (if any), 2) develop jeopardy-avoiding mitigation for any adverse effects to such species; and 3) once items 1-2 have been completed, initiate formal

consultation with the Department under the provisions of the California Endangered Species Act. At this time, we recommend that the State lead agency initiate informal (preliminary review) consultation with the Department to ensure that necessary coordination and expected schedule completion dates of this process are met.

This completes item f on page 3 for the Natomas Area of the scope of work. We hope this clarifies the provisions of the State Endangered Species Act. Any questions you may have should be directed to Monty Knudsen or Gary Taylor of my staff.

Sincerely,

James D. Carson
Acting Field Supervisor

cc: (w/enclosures)
AFWE, FWS, Portland, OR
SESO, FWS, Sacramento
DWR, Sacramento, CA
State Reclamation Board, Sacramento, CA
Dir., CDFG, Sacramento, CA
Reg. Mgr., Region II, CDFG, Rancho Cordova, CA

Division of Ecological Services
2800 Cottage Way, Rm. E-1303
Sacramento, California 95325

December 2, 1988

Mr. Jim Messersmith
Regional Manager, Region II
California Department of Fish and Game
1701 Nimbus Road
Rancho Cordova, California 95670

Subject: Corps of Engineers - American River Watershed Study, State Listed and Sensitive Species

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Any questions you have regarding this request should be directed to Monty Knudsen of my staff at (916) 978-4613. Thank you for your assistance.

Sincerely,

James J. McKevitt
Field Supervisor

Attachments

cc: ARD (FWE) FWS, Portland, OR
Col. Jack A. Le Cuyer, Dist. Eng., Corps of Engineers, Sacramento, CA
Dir., CDFG, Sacramento, CA
Dr. Larry Eng, CDFG, Environmental Services, Sacramento

MKnudsen/ar/11/29/88
revised, final, 12/1/88/ar
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Table State and Federally Listed Endangered, Threatened, Rare and Federal Candidate Species Found Within the American River Flood Control Study Area.

Listed Species

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Greene's legenere, *Legenere limosa* FC2
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Valley sagittaria, *Sagittaria sanfordii* FC2

SE = State-listed endangered
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FE = Federally-listed endangered
FT = Federally-listed threatened
FC1 or 2 = Federal candidate, category 1 or 2

File: CESAC - Amer. River Watershed

STATE OF CALIFORNIA—THE RESOURCES AGENCY

GEORGE DEUKMEJIAN, Governor

DEPARTMENT OF FISH AND GAME
REGION 2
1701 NIMBUS ROAD, SUITE A
RANCHO CORDOVA, CALIFORNIA 95670
(916) 355-7020

Gary ___ 1/26/89
Monty ___

JAN 24 1989

Mr. James J. McKevitt, Field Supervisor
U. S. Fish and Wildlife Service
2800 Cottage Way, Room E-1803
Sacramento, CA 95825

Dear Mr. McKevitt:

The Department of Fish and Game (DFG) has received your December 2, 1988 letter regarding the Corps of Engineers' American River Watershed Study in Placer, Eldorado, Sacramento, and Yolo Counties. Your letter requests our review of your tentative list of sensitive plants and animals that may be impacted by the Corps Project and inquires about the California Endangered Species Act (CESA).

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5. Red Hill soaproot (Chlorogalum grandiflorum), FC2.
6. Bisbee Peak rush-rose (Helianthemum suffrutescens), FC2.

The DFG recommends the project study area be surveyed by a qualified botanist and biologist to determine: 1) if any of the sensitive plants and animals on our combined lists are present within the project site, 2) potential project impacts upon them, and 3) mitigation for any adverse impacts upon these sensitive species. If any State-listed threatened or endangered species are found, CESA requires the State lead agency to request either an informal (preliminary review) or formal consultation with the DFG.

FISH AND WILDLIFE SERVICE
RECEIVED
JAN 25 1989
SACRAMENTO

As you are aware, the State Environmental Quality Act requires the State lead agency to identify and mitigate the project's impact upon not only these sensitive species, but its impact upon all the fish and wildlife resources.

If the DFG can be of further assistance, please contact Jerry Mensch, Environmental Services Supervisor, telephone (916) 355-7030.

James D. Messersmith
Regional Manager

April 24, 1989

Environmental Resources Branch

Mr. Gail Kobetich
Field Supervisor of Endangered Species
Fish and Wildlife Service
2800 Cottage Way, Room E-1823
Sacramento, California 95825

Dear Mr. Kobetich:

It is requested that you provide us a list of endangered and threatened species that may be present in the American River Watershed Investigation Project area. You provided us a list of endangered and threatened species in a letter dated August 4, 1987. Since then, the Yolo Bypass has been added as an area to consider in the project. The project boundaries in the Sacramento area (Enclosure 1) are: the Yolo Bypass from the Fremont Weir to its confluence with the Sacramento River north of Rio Vista; the North and South Natomas Area; Dry Creek; Arcade Creek; and the lower American River from Nimbus Dam downstream to the confluence with the Sacramento River. Project boundaries in the Upper American River (Enclosure 2) include the North and Middle Forks of the American River from the proposed Auburn Dam site upstream to approximately Shirttail Canyon and Buckeye Point, respectively.

With the exception of the Yolo Bypass, brief descriptions of project alternatives for each area are enclosed. In the Yolo Bypass, the Corps is considering modification (lowering) of the Fremont Weir. This would allow flood waters to be diverted from the Sacramento River into the Yolo Bypass at lower river stages, possibly resulting in more frequent and longer periods of inundation within the bypass during the winter.

The various flood control alternatives may affect endangered or threatened species in several ways. Lowering of the Fremont Weir will probably not adversely impact terrestrial plant or animal species in the floodway, but altered bypass flow characteristics could influence winter fish populations. Construction activities associated with levees in the Natomas and lower American River areas may impact existing waterways and result in the loss of some riparian habitat. Impacts occurring in the upper American River area would be caused by inundation of any species occurring along the North and Middle Fork slopes to an elevation of approximately 950 feet.

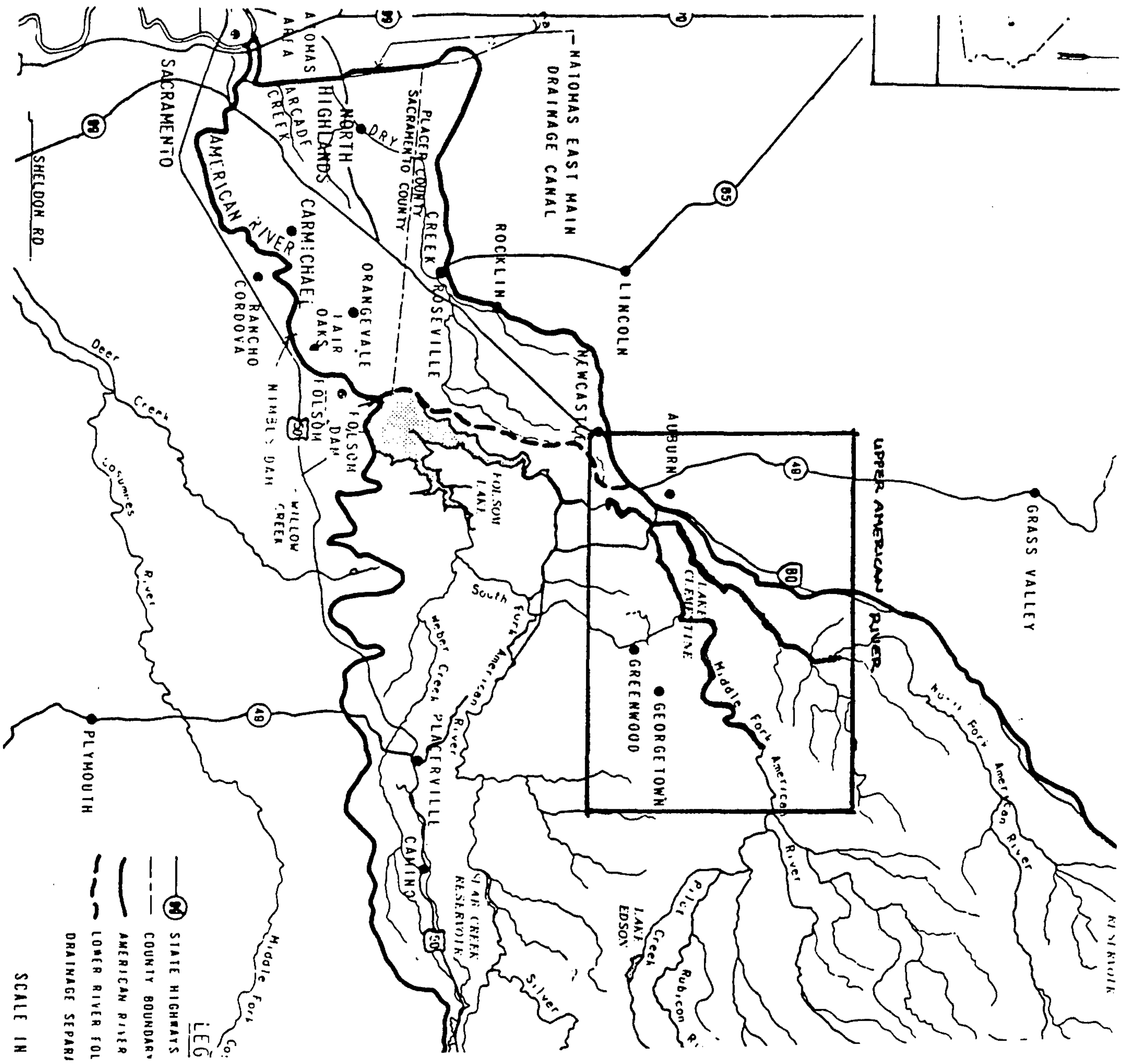
The endangered species information we are requesting from you will assist us in complying with the Endangered Species Act, as amended, and in our continued studies for the project. If you have any questions concerning this matter, please call Mr. Mark Sogge at (916) 551-1860. We would appreciate a reply within 30 days.

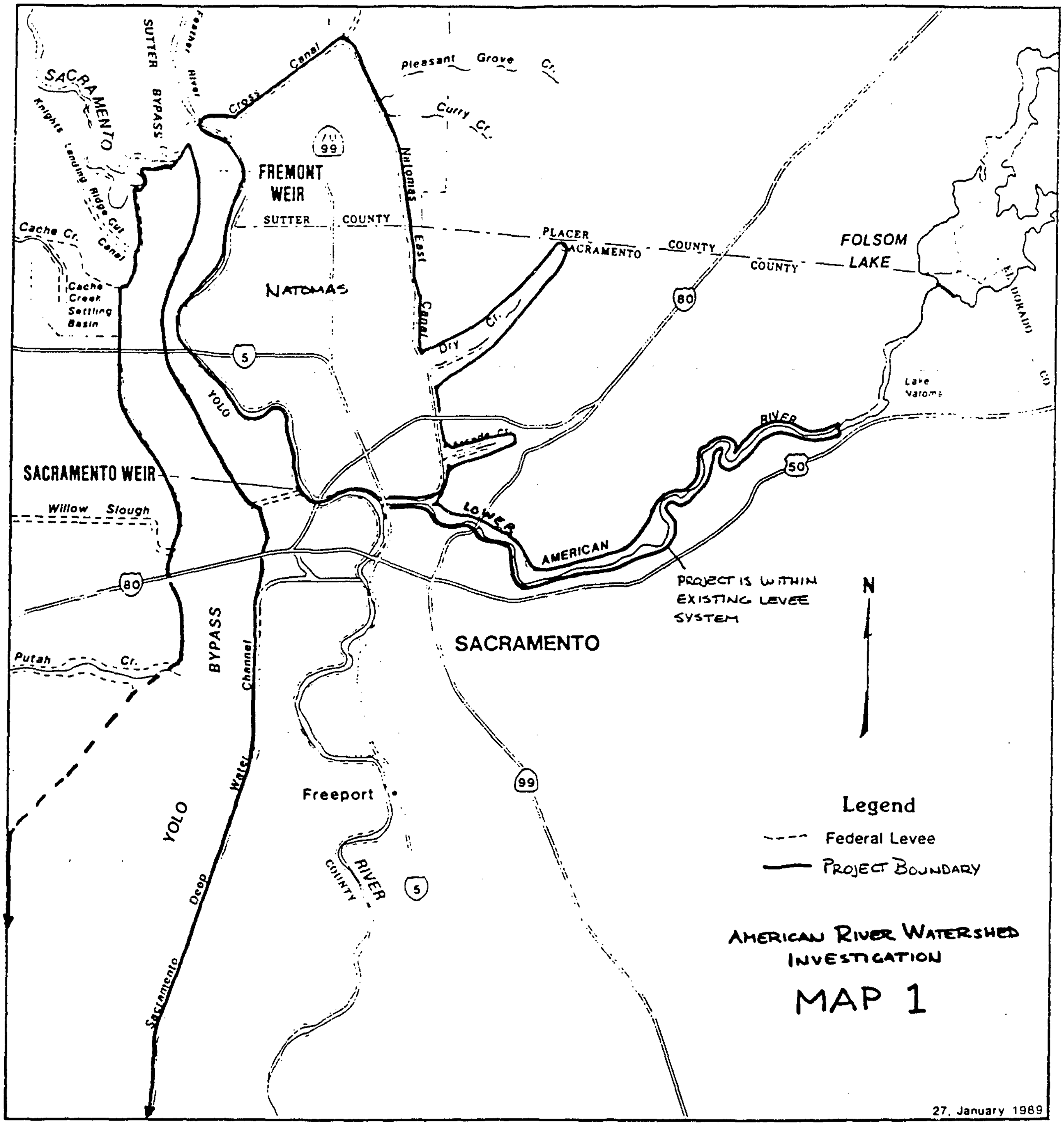
Sincerely,

Walter Yep
Chief, Planning Division

Enclosures

cc: W/Encls
Plng Div
ERB (Sogge)
ARB


NATOMAS EAST MAIN DRAINAGE CANAL
PLACER COUNTY
SACRAMENTO COUNTY
DRY CREEK
ROCKLIN
LINCOLN
ROSEVILLE
AUBURN
UPPER AMERICAN RIVER
GRASS VALLEY
NORTH HIGHLANDS
ARCADE CREEK
SACRAMENTO
AMERICAN RIVER
CARMICHAEL
ORANGEVALE
FAIR OAKS
RANCHO CORDOVA
FOLSOM
FOLSOM DAM
FOLSOM LAKE
WILLOW CREEK
SHELDON RD
GREENWOOD
GEORGETOWN
Middle Fork American River
South Fork American River
Weber Creek
PLACERVILLE
CAMINO
LAKE EDSON
Deer Creek
PLYMOUTH
Middle Fork
STATE HIGHWAYS
COUNTY BOUNDARY
AMERICAN RIVER
SCALE IN


SACRAMENTO
SUTTER BYPASS
Feather River
Cross Canal
Pleasant Grove Cr.
Curry Cr.
99
FREMONT WEIR
Knights Landing Ridge Cut Canal
SUTTER COUNTY
PLACER COUNTY
SACRAMENTO COUNTY
FOLSOM LAKE
Cache Cr.
Cache Creek Settling Basin
NATOMAS
East Natomas Canal
Dry Cr.
80
5
YOLO
Lake Natoma
EL DORADO CO.
RIVER
50
SACRAMENTO WEIR
Willow Slough
LOWER AMERICAN
PROJECT IS WITHIN EXISTING LEVEE SYSTEM
N
YOLO BYPASS
Putah Cr.
SACRAMENTO
Sacramento Deep Water Channel
Freeport
99
RIVER COUNTY
YOLO
Legend
Federal Levee
Project Boundary
AMERICAN RIVER WATERSHED INVESTIGATION
MAP 1
27. January 1989

PROJECT DESCRIPTION

American River Watershed Investigation.

General: The American River Watershed drains about 2,100 square miles along the western slope of the Sierra Nevada mountains in northern California. It includes three principal streams (North, Middle, and South Forks), which flow generally westward into Folsom Lake, located just east of the city of Sacramento. Folsom Lake, and a complex system of levees along the American and Sacramento Rivers and tributaries, provide flood protection to the highly urbanized Sacramento area. In February of 1986, major storms caused record flood flows in the American River Basin. A reanalysis of the basin hydrology after the flood event indicated that the existing flood control system provides significantly less than a 100-year level of protection to much of the Sacramento area. This includes the rapidly developing Natomas area just north of downtown Sacramento. Prior flood protection estimates were in excess of the 100-year level. The 100-year flood is an event that has a one percent chance of occurring in any given year.

Study Status:

The reconnaissance phase study was initiated in January 1987 and completed in January 1988. The primary conclusions of the study were: (1) there is a significant flood threat, (2) there are feasible solutions to this threat, and (3) feasibility phase studies are warranted. Feasibility report studies, which are expected to recommend an implementable solution to the flood problem, were initiated on 1 July 1988. The non-Federal sponsor for this cost-shared study is the State of California Department of Water Resources and The Reclamation Board.

Alternatives Under Consideration:

On the American River, the feasibility studies will focus on peak flow detention dam options and modifications to existing flood control structures along the lower American River. The dam options include a flood control only dam, a flood control dam that will not preclude future enlargement, and a flood control dam with a minimum pool for local water supply. Various alternatives along the lower American River will also be examined. In the Natomas area, alternatives will include levee and channel improvements and pumping facilities to protect the entire area or various portions of the area. Coordination action is underway to include Fremont Weir and vicinity into this study.

A. American River

1. Flood Control Only Dam. This alternative is a flood control only dam to be constructed on the North Fork of the American River below its confluence with the Middle Fork of the American River and above Folsom Reservoir at or near the existing

uncompleted Auburn Dam site. The facility would be designed to act in conjunction with seasonal flood control storage in Folsom Reservoir to maintain the current maximum objective release of 115,000 cubic feet per second (cfs) from Folsom Reservoir into the lower American River during large flood events. The dam would allow the river to flow unimpeded into Folsom Reservoir most of the time. During high flows, however, the dam would temporarily (1 to 12 days) store between 600,000 and 700,000 AF of water to permit optimum operation of the downstream flood control system.

2. Expandable Dam. The second alternative is a flood control only dam, as described above, but designed not to preclude future expansion into a larger multipurpose reservoir for flood control, water supply, hydropower, and recreation. Such a facility may include additional foundation work, construction of facilities to more easily allow future outlet work modifications, alternative siting, and/or the purchase of lands which may be required in the future.

3. Minimum Pool. The third alternative is a flood control dam with a minimum pool. The facility would be designed to store and divert a yet-to-be-determined, non-firm water supply to the local area (Placer and El Dorado Counties). This option would entail the permanent inundation of portions of the North and Middle Forks of the American River.

4. Others. Other alternatives that will be considered are non-dam options capable of providing levels of flood protection significantly less than 200-year. One such option includes enlargement of the levees along the lower American River to accommodate increased objective discharges from Folsom Dam. An increased release of approximately 180,000 cfs would be considered. Other options include a permanent increase in the flood storage allocation in Folsom Reservoir, and structural modifications of Folsom Dam to permit earlier releases of flood waters. These options individually, or in various combinations, would provide levels of flood protection between 70-and 150-years.

5. No Action. Under this alternative, the Federal government would not participate in flood control efforts. This alternative constitutes the without-project future for the basis of comparative economic, environmental, and engineering studies.

B. Natomas Area

1. Full Natomas Protection. This alternative would protect the entire 53,000 acre Natomas area through the use of pump stations and levee enlargement. Modifications to the Fremont Weir and provisions for a diversion structure in the Sacramento River are also being viewed as possible alternatives.

2. Partial Natomas Protection. Two alternative cross

levee alignments, designed to protect various proportions of the Natomas area, will be examined. In addition to the construction of a cross levee, existing levees along the Sacramento and American Rivers, the Natomas East Main Drainage Canal, the Pleasant Valley Creek Canal, and the Natomas Cross Canal could be enlarged.

3. No Action. Under this alternative, the Federal government would not participate in flood control efforts. This alternative constitutes the without-project future for the basis of comparative economic, environmental, and engineering studies.

Coordination and Public Involvement:

The Corps of Engineers, in cooperation with the Department of Water Resources and the Reclamation Board, have developed a multi-faceted program to involve the public and affected public agencies. The highlights of the program are:

- Executive Committee Meetings (quarterly), which includes executives of the Corps, Sacramento District, and chief executives of the city, counties, state agencies and local sponsors.

- Study Management Team Meeting (bi-monthly), which includes COE study manager and staff members of various local and state entities and other Federal agencies.

- Series of Public Involvement Meetings and Scoping Workshops.

- A public meeting for the Draft Report is scheduled for July 1990.

- Presentations to numerous fraternal and civic organizations.

- Periodic mailings of newsletter to interested groups and individuals.

Schedule:

A draft Feasibility Report/Environmental Impact Statement is scheduled for completion in June 1990 and the final report in October 1990. The report will then undergo Washington-level review and consideration for recommendation for Congressional authorization and funding.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Endangered Species Office
2800 Cottage Way, Room E-1823
Sacramento, California 95825-1846

In Reply Refer To:
1-1-89-SP-631

May 18, 1989

Mr. Walter Yep
Chief, Planning Division
Department of the Army
Sacramento District Corps of Engineers
650 Capitol Mall
Sacramento, California 95814-4794

Subject: Species List for the American River Watershed Investigation Project Area, California

Dear Mr. Yep:

As requested by letter from your agency dated April 24, 1989, you will find attached lists of the listed endangered and threatened species that may be present in the subject project area. (See Attachments A and AA.) One list addresses species found in the lower Sacramento River and Delta; the second focuses on species found in the upper American River. To the best of our knowledge, no proposed species occur within the area. These lists fulfill the requirement of the Fish and Wildlife Service to provide species lists pursuant to Section 7(c) of the Endangered Species Act, as amended.

Some pertinent information concerning the distribution, life history, habitat requirements, and published references for the listed species is also attached. This information may be helpful in preparing the biological assessment for this project, if one is required. Please see Attachment B for a discussion of the responsibilities Federal agencies have under Section 7(c) of the Act and the conditions under which a biological assessment must be prepared by the lead Federal agency or its designated non-Federal representative.

Formal consultation, pursuant to 50 CFR § 402.14, should be initiated if you determine that a listed species may be affected by the proposed project. Informal consultation may be utilized prior to a written request for formal consultation to exchange information and resolve conflicts with respect to a listed species. If a biological assessment is required, and it is not initiated within 90 days of your receipt of this letter, you should informally verify the accuracy of this list with our office.

Also, for your consideration, we have included lists of the candidate species that may be present in the project area. (See Attachments A and AA.) These species are currently being reviewed by our Service and are under consideration for possible listing as endangered or threatened. Candidate species have no protection under the Endangered Species Act, but are included

for your consideration as it is possible that one or more of these candidates could be proposed and listed before the subject project is completed. Should the biological assessment reveal that candidate species may be adversely affected, you may wish to contact our office for technical assistance. One of the potential benefits from such technical assistance is that by exploring alternatives early in the planning process, it may be possible to avoid conflicts that could otherwise develop, should a candidate species become listed before the project is completed.

Please contact Peggie Kohl at 916/978-4866 (FTS 460-4866) if you have any questions regarding the attached lists or your responsibilities under the Endangered Species Act.

Sincerely,

Gail C. Kobetich

Gail C. Kobetich
Field Supervisor

Attachments

ATTACHMENT A

LISTED ENDANGERED AND THREATENED SPECIES AND
CANDIDATE SPECIES THAT MAY OCCUR IN THE AREA OF THE PROPOSED
AMERICAN RIVER WATERSHED INVESTIGATION PROJECT AREA
[SACRAMENTO AREA]
(1-1-89-SP-631)

Listed Species

Birds

American peregrine falcon, *Falco peregrinus anatum* (E)
bald eagle, *Haliaeetus leucocephalus* (E)

Invertebrates

valley elderberry longhorn beetle, *Desmocerus californicus dimorphus* (T)

Candidate Species

Birds

tricolored blackbird, *Agelaius tricolor* (2)

Fishes

Sacramento splittail, *Pogonichthys macrolepidotus* (2)
Sacramento perch, *Archoplites interruptus* (2)

Reptiles

giant garter snake, *Thamnophis couchi gigas* (2)

Amphibians

California tiger salamander, *Ambystoma tigrinum californiense* (2)

Invertebrates

Sacramento Valley tiger beetle, *Cicindela hirticollis abrupta* (2R)
Sacramento anthicid beetle, *Anthicus sacramento* (2)

Plants

hispid bird's-beak, *Cordylanthus mollis* subsp. *hispidus* (2)
Boggs Lake hedge-hyssop, *Gratiola heterosepala* (2)
legenere, *Legenere limosa* (2)
valley sagittaria, *Sagittaria sanfordii* (2)

(E)--Endangered (T)--Threatened (CH)--Critical Habitat
(1)--Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.
(2)--Category 2: Taxa for which existing information indicated may warrant listing, but for which substantial biological information to support a proposed rule is lacking.
(2R)-Recommended for Category 2 status.

ATTACHMENT AA

LISTED ENDANGERED AND THREATENED SPECIES AND
CANDIDATE SPECIES THAT MAY OCCUR IN THE AREA OF THE PROPOSED
AMERICAN RIVER WATERSHED INVESTIGATION PROJECT AREA
[UPPER AMERICAN RIVER]
(1-1-89-SP-631)

Listed Species

Birds

American peregrine falcon, *Falco peregrinus anatum* (E)
bald eagle, *Haliaeetus leucocephalus* (E)

Candidate Species

Birds

tricolored blackbird, *Agelaius tricolor* (2)
spotted owl, *Strix occidentalis* (2)

Amphibians

California red-legged frog, *Rana aurora draytoni* (2)

Invertebrates

spiny rhyacophilian caddisfly, *Rhyacophila spinata* (2)
Darlington's ground beetle, *Nebria darlingtoni* (2R)

(E)--Endangered (T)--Threatened (CH)--Critical Habitat
(1)--Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.
(2)--Category 2: Taxa for which existing information indicated may warrant listing, but for which substantial biological information to support a proposed rule is lacking.
(2R)-Recommended for Category 2 status.

ATTACHMENT B

FEDERAL AGENCIES' RESPONSIBILITIES UNDER
SECTIONS 7(a) and (c) OF THE ENDANGERED SPECIES ACT

SECTION 7(a) Consultation/Conference

Requires: 1) Federal agencies to utilize their authorities to carry out programs to conserve endangered and threatened species; 2) Consultation with FWS when a Federal action may affect a listed endangered or threatened species to insure that any action authorized, funded or carried out by a Federal agency is not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat. The process is initiated by the Federal agency after determining the action may affect a listed species; and 3) Conference with FWS when a Federal action is likely to jeopardize the continued existence of a proposed species or result in destruction or adverse modification of proposed critical habitat.

SECTION 7(c) Biological Assessment--Major Construction Activity[1]

Requires Federal agencies or their designees to prepare a Biological Assessment (BA) for major construction activities. The BA analyzes the effects of the action[2] on listed and proposed species. The process begins with a Federal agency requesting from FWS a list of proposed and listed threatened and endangered species. The BA should be completed within 180 days after its initiation (or within such a time period as is mutually agreeable). If the BA is not initiated within 90 days of receipt of the list, the accuracy of the species list should be informally verified with our Service. No irreversible commitment of resources is to be made during the BA process which would foreclose reasonable and prudent alternatives to protect endangered species. Planning, design, and administrative actions may proceed; however, no construction may begin.

We recommend the following for inclusion in the BA: an on-site inspection of the area affected by the proposal which may include a detailed survey of the area to determine if the species or suitable habitat are present; a review of literature and scientific data to determine species' distribution, habitat needs, and other biological requirements; interviews with experts, including those within FWS, State conservation departments, universities and others who may have data not yet published in scientific literature; an analysis of the effects of the proposal on the species in terms of individuals and populations, including consideration of indirect effects of the proposal on the species and its habitat; an analysis of alternative actions considered. The BA should document the results, including a discussion of study methods used, any problems encountered, and other relevant information. The BA should conclude whether or not a listed or proposed species will be affected. Upon completion, the BA should be forwarded to our office.

---

[1] A construction project (or other undertaking having similar physical impacts) which is a major Federal action significantly affecting the quality of the human environment as referred to in NEPA (42 U.S.C. 4332(2)C).

[2] "Effects of the action" refers to the direct and indirect effects on an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action.

AMERICAN PEREGRINE FALCON

(Falco peregrinus anatum)

CLASSIFICATION:

Endangered 35 **Federal Register** 16047, October 13, 1970, and 49 **Federal Register** 10526, March 20, 1984.

CRITICAL HABITAT: Designated in Sonoma, Napa, and Lake Cos.

DESCRIPTION:

A medium-sized, swift flying bird of prey with pointed wings. Wingspan is 3 to 4 feet. Adults have slate gray backs with white underparts that are streaked or barred in black. They have distinctive white and black facial markings.

DISTRIBUTION:

Historically nested throughout North America from the boreal forest south into Mexico, wherever suitable nesting and foraging habitat occurred. Remnant breeding populations currently occur in California, Arizona, New Mexico, Utah, Texas, and Alaska. A few pairs nest in other states in the northeast and northwest.

SPECIAL CONSIDERATIONS:

The American peregrine falcon has suffered major population declines due principally to DDT contamination of their food chain. With the banning of DDT for use in the U.S. in 1972 and implementation of a management program, populations have for the most part stabilized. Unfortunately, pesticide data indicate that there has been a continued input of DDT into the local environments. Some nest sites are now protected from human disturbance. Poor quality eggs are taken from the wild for artificial incubation, and young are placed in nests after hatching from wild eggs taken into captivity or laid by captive parents.

REFERENCES FOR ADDITIONAL INFORMATION:

J. J. Hickey (ed). 1969. Peregrine falcon populations their biology and decline. Univ. of Wisconsin Press. Madison, WI.

Ratcliffe, D. 1980. The peregrine falcon. Buteo Books. Vermillion, SD.

U.S. Fish and Wildlife Service. 1982. Pacific Coast Recovery Plan for the American Peregrine Falcon. Portland, OR. 87 pp.

BALD EAGLE
(Haliaeetus leucocephalus)

CLASSIFICATION:

Endangered (**Federal Register** 43:633; February 14, 1978).

CRITICAL HABITAT: None designated.

DESCRIPTION:

Next to the California condor, the bald eagle is the largest bird in California with a wingspan measuring 6 to 7 feet. Adults are brownish black with a white head and tail and yellow bill. Immatures are variously brownish black.

DISTRIBUTION:

Bald eagles can and do occur virtually anywhere in California during migration. They nest near water bodies in the northern portion of the state and winter throughout the state wherever suitable prey resources are available.

SPECIAL CONSIDERATIONS:

Although some bald eagle populations began to decline in the 19th century due to human persecution and habitat loss, the drastic declines in reproduction experienced by most eagle populations occurred between 1947 and 1970. Research indicated that certain organochlorine pesticides interfered with productivity, and other pesticides were responsible for direct mortalities. Most bald eagle populations are now stable or increasing in numbers.

REFERENCES FOR ADDITIONAL INFORMATION:

Detrich, P. J. 1986. The status and distribution of the bald eagle in California. M. S. Thesis. Chico State Univ., CA

Frenzel, R. W. 1984. Ecology and environmental contaminants of bald eagles in southcentral Oregon. Ph.D. Thesis. Oregon State Univ., Corvallis, OR.

Lehman, R. N., D. E. Craigee, P. L. Collins, and R. S. Griffen. 1980. An analysis of habitat requirements and site selection criteria for nesting bald eagles in California. Report by Wilderness Research Institute, Arcata, CA for U.S. Forest Service, Region 5, San Francisco, CA.

U.S. Fish and Wildlife Service. 1986. Recovery plan for the Pacific Bald Eagle. Portland, OR.

VALLEY ELDERBERRY LONGHORN BEETLE

(*Desmocerus californicus dimorphus*)

CLASSIFICATION: Threatened - **Federal Register** 45:FR52803 August 8, 1980.

CRITICAL HABITAT: Federal Register 17.95(c), May 7, 1980.

California. Sacramento County.

(1) Sacramento Zone. An area in the city of Sacramento enclosed on the north by the Route 160 Freeway, on the west and southwest by the Western Pacific railroad tracks, and on the east by Commerce Circle and its extension southward to the railroad tracks.

(2) American River Parkway Zone. An area of the American River Parkway on the south bank of the American River, bounded on the north by latitude 38 37'30" N, and on the South and east by Ambassador Drive and its extension north to latitude 38 37'30" N, Goethe Park, and that portion of the American River Parkway northeast of Goethe Park, west of the Jedediah Smith Memorial Bicycle Trail, and north to a line extended eastward from Palm Drive.

(3) Putah Creek Zone. California. Solano County. R 2 W T. 8 N. Solano County portion of Section 26.

DESCRIPTION:

Horn described the valley elderberry longhorn beetle in 1881 and it was redescribed in 1921 by Fisher. Morphological description: In general, longhorn beetles are characterized by somewhat elongate and cylindrical bodies with long antennae, often in excess of 2/3 of the body length. In contrast, males of VELB are stout-bodied and their elytra (thickened, hardened forewings) are coarsely punctured, with a metallic-green pattern of 4 oblong maculations, surrounded by a bright red- orange border. The border eventually fades to yellow on museum specimens. The maculations are fused on some males, more closely resembling the nominate subspecies. Antennae are about as long as the body or slightly shorter. Body length is about 13-21 mm.

Females are more robust, elytra are subparallel, and the dark pattern is not reduced. Antennae reach to about the middle of the elytra and body length is about 18-25 mm. Both sexes of VELB are readily identified due to their distinctive appearance. As noted earlier, males with fused maculations resemble the nominate subspecies, *Desmocerus californicus dimorphus*, Fisher, 1921.

DISTRIBUTION:

VELB is endemic to moist valley oak woodlands along the margins of rivers and streams in the lower Sacramento and upper San Joaquin Valley of California, where elderberry (*Sambucus* spp.), its foodplant, grows. During the past 150 years over 90

percent of the riparian habitat in California has been destroyed by agricultural and urban development. Although the entire historical distribution of VELB is unknown, the extensive destruction or riparian forests of the Central Valley of California strongly suggests that the beetle's range may have shrunk and become greatly fragmented.

Due to the limited knowledge about the VELB's life history, and its ecological requirements, precise threats to its survival are difficult to enumerate. Clearly the primary threat to survival of the VELB has been and continues to be loss and alteration of habitat by agricultural conversion, grazing, levee construction, stream and river channelization, removal of riparian vegetation, rip-rapping of shoreline, plus recreational, industrial and urban development. Insecticide and herbicide use in agricultural areas may be factors limiting the beetle's distribution. The age and quality of individual elderberry shrubs/trees and stands as a foodplant for VELB may also be a factor in the beetle's limited distribution.

There is little information on former abundance of VELB for comparison with current population levels. A. T. McClay collected 51 adults during May 1947. Dr. John A. Chemsak, a cerambycid specialist from the University of California, Berkeley, believes that VELB has probably always been rather rare and of limited abundance.

SPECIAL CONSIDERATION:

The riparian habitat of the beetle is still being degraded by urban development and levee repair work along the rivers. There has been some successful elderberry transplantings in specific areas along the rivers. This has increased the viable habitat for the beetle.

Special recovery efforts needed: Protect the only known VELB colonies; conduct further research on life history and habitat requirements of VELB; survey areas in Central Valley of California to locate additional colonies; formulate management plans as appropriate information on VELB's biology becomes available; establish VELB at rehabilitated habitat sites within present-day range; monitor VELB colonies to determine population status and success of management actions as implemented; increase public awareness of VELB through educational and information programs. Studies on the physiological requirements of the beetle and of the elderberry plants are needed.

REFERENCES FOR ADDITIONAL INFORMATION:

Arnold, R. A. 1984. Interim report for contract C-616 with the California Department of Fish and Game. 14 pp.

Burke, H.E. 1921. Biological notes on *Desmocerus*, a genus of roundhead borers, the species of which infests various elders. J. Econ. Ent. 14:450-452.

Craighead, F.C. 1923. North American cerambycid larvae. A clarification and the biology of North American cerambycid larvae. Can. Dept. Ag., Ottawa. Bull. 27. 239 pp.

Eng, L.L. 1984. Rare, threatened, and endangered invertebrates in California riparian systems. Pp. 915-919, in R. E. Warner and K. M. Hendrix (eds). California Riparian Systems: Ecology, Conservation, and Productive Management. University of California Press, Berkeley. 1035 pp.

Eya, B.K. 1976. Distribution and status of a longhorn beetle, *Desmocerus californicus dimorphus* Fisher (Coleoptera: Cerambycidae). Unpublished ms. 6 pp.

Jones and Stokes. 1985 and 1986. Survey of habitat and population of the valley elderberry longhorn beetle along the Sacramento River, 1985 Progress Report. 46 pp., A 1 and 2 86 pp.

Linsley, E. G., and J. A. Chemsak. 1972. Cerambycidae of North America, part No. 1. Taxonomy and classification of the sub-family Lepturinae. University of California publ. Entomol. Vol. 69.

Western Ecological Services Company (WESCO). Undated. Lower San Joaquin River snagging and clearing project endangered species data report; valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*). Report submitted to U.S. Army Engineer District, Sacramento. Contract No. DACW05-84-P-1051. 15 pp.

U.S. Fish and Wildlife Service. 1984. Valley elderberry longhorn beetle recovery plan. U.S. Fish and Wildlife Service, Portland, Oregon. 62 pp.

Memorandum

Date : MAY 02 1989

To : A-43
Peter F. Bontadelli, Director
Department of Fish and Game
1416 Ninth Street, 12th Floor
Sacramento, CA 95814

From : Department of Water Resources

Subject : Consultation Under the California Endangered Species Act

The U. S. Army Corps of Engineers, under authorization by Congress, is engaged in a one-year reconnaissance study of alternative means of flood control in the American River watershed. The Reclamation Board is the local sponsor and lead agency under the California Environmental Quality Act for the investigation. The Department of Water Resources will aid The Reclamation Board in the work required by CEQA and the California Endangered Species Act.

The project consists of levee reinforcement and construction in the Natomas and Lower American River portion of the watershed and the construction of a dam on the North Fork of the American River near Auburn. We would like to proceed with the consultation process described in the "Guidelines for Consulting with the Department of Fish and Game on Projects Subject to CEQA That May Affect Endangered and Threatened Species".

To facilitate matters, DWR has forwarded the project reconnaissance report and a retrieval from the Natural Diversity Data Base of the project area to Bob Orcutt of the Environmental Services Branch of DFG, Region 2. We would like to meet as soon as possible with DFG to discuss the appropriate course of action in addressing the requirements for this project concerning the endangered species.

If you have any questions, please contact me or have your staff contact Bellory Fong of my staff at ATSS 485-4640.

(sgd) David N. Kennedy

David N. Kennedy
Director
ATSS 485-6582

cc: Raymond E. Barsch, General Manager
The Reclamation Board
1416 Ninth Street, Room 455-6
Sacramento, CA 95814

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
300 South Ferry Street
Terminal Island, CA 90731

November 16, 1989 F/SWR14:JHL

Walter Yep
Chief, Planning Division
Department of the Army
Sacramento District Corps of Engineers
650 Capitol Mall
Sacramento, CA 95814-7415

Dear Mr. Yep:

This is in response to your request of September 20, 1989, for information on the presence of winter-run chinook salmon in the areas affected by the American River Watershed, Folsom Reservoir Reoperation, Sacramento Metropolitan Area, and Dry Creek Investigations. Winter-run are not likely to be found in any of these project areas.

Also included with your letter was a Notice of Initiation of Reconnaissance Study For Flood Control Yuba River Basin Investigation, dated July 5, 1989. Winter-run are not likely to occur in the Yuba River Basin either.

The Section 7 consultation process can be concluded for these investigations. However, we would appreciate being kept informed of any construction projects that are proposed as a result of these investigations. We would like to review them for potential indirect effects on winter-run in the Sacramento River.

Sincerely,

E C Fullerton
E. C. Fullerton
Regional Director

State of California

The Resources Agency

Memorandum

To : Mr. Raymond E. Barsch, General Manager
The Reclamation Board
1416 Ninth Street, Room 455-6
Sacramento, CA 95814

Date July 2, 1990

From : Department of Fish and Game

Subject: California Endangered Species Act (CESA) Consultation for the American River Watershed Investigation, Preliminary Report on Impacts to State-Listed Species in the Natomas Portion (American Basin) of the Project

Pursuant to sections 2090 through 2093 of CESA, the California Department of Fish and Game provides written findings as to whether proposed projects would jeopardize any threatened, endangered, or State-candidate species or result in the destruction or adverse modification of habitat essential to the continued existence of such species. The attached comments constitute the Department's preliminary evaluation of the project impacts to the State-listed threatened Swainson's hawk (Buteo swainsonii), the State-listed threatened giant garter snake (Thamnophis couchi gigas) and the State-listed endangered and Federally-listed threatened Sacramento winter-run chinook salmon (Oncorhynchus tshawytscha). These comments are confined to project-related adverse impacts in the Natomas area of Sacramento County and adjacent portions of Sutter County as they relate to the above-mentioned species. A formal Biological Opinion will be provided to The Reclamation Board once a final project design has been selected and all project-related adverse impacts have been identified. In order to complete formal consultation, the Department requires a current land use map of the Natomas area indicting the current agricultural cropping patterns for identification of essential Swainson's hawk foraging habitat and the release of U.S. Fish and Wildlife Service Coordination Act Report for this project. It is anticipated that this will occur subsequent to the release of the Draft Environmental Impact Statement/Environmental Impact Report for this project.

If you are in need of further assistance, please contact Mr. David Showers, Associate Wildlife Biologist, Environmental Services Division, Department of Fish and Game, telephone 322-5655.

Pete T. Bontadelli

L. Pete Bontadelli
Director

Attachment

CALIFORNIA ENDANGERED SPECIES ACT (CESA)
PRELIMINARY REPORT
American River Watershed Investigation:
Natomas Area, Sacramento and Sutter Counties

The State Reclamation Board has requested a determination from the California Department of Fish and Game as to whether the proposed American River Watershed Investigation project would jeopardize the continued existence of any State candidate, threatened, or endangered species. Pursuant to sections 2090 through 2093 of the California Endangered Species Act (CESA), the Department has prepared preliminary comments in regard to potential impacts to State-listed species in the Natomas region of the project. These comments are being provided to assist the Reclamation Board at the initial stages of project development.

Project Description

A reconnaissance report for the American River Watershed was completed by the Army Corps of Engineers in January 1988. That study concluded that there are serious flood problems in the Sacramento area, that there are economically feasible solutions to resolve these problems, and that a feasibility scope investigation was warranted. Accordingly, the reconnaissance report included a recommendation that feasibility studies proceed for the mainstem American River and Natomas areas. A Feasibility Cost Sharing Agreement (FCSA) for the feasibility study was signed between the Corps and non-Federal sponsors made up of the California State Reclamation Board and California Department of Water Resources. An Environmental Impact Statement/Environmental Impact Report (EIS/EIR) is due to be released for this project in August 1990.

Flood protection for the Natomas area would involve raising and strengthening levees. The goal is to protect the approximately 55,000 acre Natomas area bounded by the Natomas East Main Drain and Pleasant Grove Creek Canal on the east, Natomas Cross Canal on the north, Sacramento River on the west and Natomas East Main Drain, Sacramento River and American River on the south (Corps of Engineers 1990). Additionally, areas of Dry Creek, Arcade Creek and the upper 8 miles of the Yolo Bypass could be included as areas of improvement for flood control for a total of over 60,000 acres.

The direct project-related impacts to fish and wildlife resources from levee construction activities will be limited. The Army Corps of Engineers have identified much larger secondary impacts due to growth as a result of land conversion and urbanization in Natomas over the life of the project.

Listed Species:

Swainson's Hawk

The State-listed Threatened Swainson's hawk is a medium-sized buteo with relatively long, pointed wings and a long, square tail. The wings are bicolored underneath with the wing linings generally lighter than the dark flight feathers. Adult females weigh 28 to 34 ounces and males 25 to 31 ounces.

Swainson's hawks breeding in California spend the winter in South America as far south as Argentina. The diet of the Swainson's hawk is varied with the California vole (Microtus californicus) being the staple in the Central Valley. A variety of birds and insects are also taken. Swainson's hawks require large, open grasslands with abundant prey in association with suitable nest trees. Suitable foraging areas include native grasslands or lightly-grazed pastures, alfalfa and other hay crops and certain grain and row croplands. Unsuitable foraging habitat includes croplands in which prey are scarce or unavailable due to the density of the vegetative cover. Those include vineyards, orchards, rice, corn and cotton crops. Suitable nest sights may be found in mature riparian forest, lone trees or groves of oaks and other species in agricultural fields and mature roadside trees. Over 85 percent of Swainson's hawk territories in the Central Valley are in riparian systems adjacent to suitable foraging habitats.

Swainson's hawks were once found throughout lowland California and were absent only from the Sierra Nevada, north coast ranges and Klamath Mountains and portions of the desert regions of the State. Today, the distribution of Swainson's hawks in California is restricted to portions of the Central Valley and Great Basin regions where suitable nesting and foraging habitat is still available. In the Central Valley, the trend toward planting of more and more crops that are unsuitable for Swainson's hawks (e.g., vineyards, orchards, rice) and urban expansion onto surrounding agricultural and grassland areas further threatens the population. Residential and commercial development of foraging habitat is becoming increasingly prevalent in the center of Swainson's hawk distribution in the Central Valley, particularly in Yolo, Sacramento and San Joaquin counties.

Giant Garter Snake

This is one of the largest garter snakes, with females reaching up to 4 feet total length. It is a dull brown snake with a checkered pattern of well-separated black spots on the dorsal side and a dull yellow mid-dorsal stripe.

The giant garter snake (Thamnophis couchi gigas) is a state threatened species endemic to the Sacramento and San Joaquin valleys where it presently occurs in a clumped distribution from Butte County to Fresno County. It has been extirpated from the San Joaquin Valley south of Fresno County and has recently suffered serious declines in southern Sacramento County. Giant garter snakes in the southern Sacramento Valley inhabit aquatic habitats generally between 10 and 40 feet elevation which are characterized by slow flowing or standing water, emergent vegetation, and abundant forage species (frogs, including bullfrogs, tadpoles and small fish). They may utilize seasonal water, however, the water must be present during the "summer" (active) season. The presence of elevated natural or manmade features is important to provide refugia in areas subject to winter flooding. Giant garter snakes are generally absent in areas where large, exotic predatory fish, especially black and striped bass, are well established. They also appear to avoid larger bodies of open water and areas where the banks are only lightly vegetated. Where the option exists, tules are selected over cattails. Giant garter snakes are highly aquatic, apparently avoid areas of dense riparian overstory and usually occur in waterways with mud bottoms and dirt banks. The valley garter snake, Thamnophis sirtalis fitchi, occurs throughout the range of the giant garter snake.

Sacramento Winter-run Chinook Salmon

The State-listed endangered and Federally-listed threatened Sacramento winter-run chinook salmon is a distinct race of chinook salmon (Oncorhynchus tshawytscha). Other races which utilize the Sacramento River are the fall-run, the late fall-run and the spring-run. These races can be distinguished by the timing of adult migration and spawning and the timing of smolt migration. Sacramento winter-run chinook occur only in California and virtually all spawning is limited to the mainstem Sacramento River. Adults migrate past the Red Bluff Diversion Dam (RBDD) on the Sacramento River beginning in mid-December and continuing through July. Most fish spawn upstream of RBDD in May, June, and July with some spawning in early August. Downstream migrant smolts move past Red Bluff beginning in August and continue through October.

The Sacramento winter-run chinook salmon population has declined greatly in recent years. Annual runs for the past five years have averaged about 2,000 fish compared with the 60,000 to 120,000 spawners typical of the 1960s. In 1989, the spawning escapement dropped to 547 fish. Similar numbers of returning fish are reported for 1990.

Project Impacts

The U.S. Fish and Wildlife Service (USFWS) has utilized the Corps of Engineers' land use projections for changes in Natomas as a result of the project to analyze the loss of wildlife habitat over time. Their preliminary figures indicate that substantial wildlife habitat will be lost over the life of the project due to growth and development attributable to increased flood protection. Over one-half (29,750 acres) of the 55,000-acre Natomas area would be converted during the next 50 years. Only 616 acres of conversion result from direct project construction impacts. By the year 2047, a total of 18,500 acres of grainfields, pasture, grasslands, and row crops would be removed from agriculture and converted to other uses (USFWS 1990a).

Specific habitat information and final analysis of impacts are not yet available for this project. Therefore, this consultation is by necessity informal and provisional pending the receipt of the required environmental documentation. In order for the Department to complete the final Biological Opinion the following information is required:

1. A current land use map of the Natomas area showing agricultural cropping patterns in order to determine important Swainson's hawk foraging areas.

2. The final U.S. Fish and Wildlife Coordination Act Report analyzing project related impacts and suggested mitigation measures.

The habitat and wildlife value of the project site were determined through the Habitat Evaluation Procedures (HEP) analysis, a standard method of determining the values impacted by projects. The USFWS does not attempt to deal with State-listed species and has not included them in their mitigation proposals for fish and wildlife impacts. Neither the Department nor USFWS uses HEP for endangered species. Therefore, a separate analysis for Swainson's hawk and giant garter snake must be accomplished.

The Natomas area reach of the Sacramento River supports one of the highest concentrations of Swainson's hawk nesting territories in California. The latest monthly report by the USFWS for Swainson's hawk monitoring of the Sacramento Urban Area Levee Reconstruction Project area identifies 33 territories from the Pocket Area north to Verona (USFWS 1990b). Nesting has been confirmed for most of these territories. All confirmed nests are located along the river in mature riparian forest trees. Opportunities to nest away from the river are limited due to the lack of suitable nest trees in Natomas. No survey in the interior of Natomas has been

conducted and the only confirmed nesting site not on the Sacramento River is at Fisherman's Lake. As indicated in the discussion of Swainson's hawk biology, the important hunting and foraging areas for Swainson's hawk are agricultural fields surrounding the nest site and can be as far as 18 miles away (Estep 1989). Loss of foraging habitat is a significant impact on the reproductive capability of individual nesting pairs. Protection of this species requires not only preservation of nest trees but also essential foraging habitat nearby. The attached draft mitigation guidelines for Swainson's hawk prepared by the Department's Region 2 office identify the necessary steps toward developing a strategy for protection of foraging habitat.

The giant garter snake will also be threatened by growth-inducing impacts in the Natomas area. The American River Basin, provides the most important habitat remaining in California for this State-listed threatened species. The myriad of connecting irrigation canals, feeder canals, drains, and riparian/marshes (Fisherman's Lake and Prichard Lake) provide essential habitat and movement corridors for the snake.

In addition to proposed flood control projects, the City of Sacramento is currently completing a North Natomas Community Drainage System Plan. The system will consist of two major open drainage channels, tributary open channels and storm drainage pipes, two pumping stations to lift storm runoff over the levee into the Sacramento River, and other related facilities.

The cumulative effect of the project described above will result in the garter snake populations in the northern (Prichard Lake) and southern (Fisherman's Lake) areas being separated, creating subpopulations with little or no opportunity for genetic exchange. It is essential to preserve the primary habitat and to maintain genetic heterogeneity by assuring that free movement of the giant garter snake continues to occur within the Natomas area. Loss of rice farming in Natomas would lead to a decline in the amount of water necessary to sustain the snake populations in remaining channels and possibly eliminate their prey base. Resulting urbanization would further degrade the habitat and threaten remaining snakes. The loss of the snake's habitat in the basin and loss of snakes to road kills caused by increased traffic may lead to reclassification of the snake to the endangered species category.

Department staff have been working with consultants for the City of Sacramento to develop a mitigation plan for their project. The Final EIR for the North Natomas Community Drainage System has not been issued, however, and the Department anticipates the City will adopt our recommendations to protect the giant garter snake in

that portion of Natomas. Combined habitat losses from City sponsored projects and federal sponsored flood control projects could lead to the extirpation of the giant garter snake from its best remaining habitat.

The flood control work in Natomas will not involve any water side construction; therefore, no impacts are anticipated to the Sacramento winter-run chinook salmon as a result of the Natomas area portion of this project.

Conditions to Avoid Jeopardy

The Department provides the following provisional recommendations in order to avoid jeopardy to the Swainson's hawk. These recommendations are based on the best available information on the biology of this species. Additional recommendations may be developed pending the completion of the necessary environmental documents for the American River Watershed Investigation and the conclusion of current studies on Swainson's hawk in the project site.

1. No disturbance in the vicinity of the nest trees during the breeding season of March 1 through August 15. Activity that may cause adults to leave the nest and abandon the young would constitute a take. Although 1/2 mile is the rule of thumb for a no activity zone around a nest site, that distance may be modified under certain conditions (i.e., screening by trees if the nest site is across the river from the worksite) with the approval of the Department.

2. All essential foraging habitat in Natomas must be protected or compensated for within the project area. The Department assumes that the Swainson's hawk habitat in Natomas is at or near carrying capacity. The large number of territories encountered in the USFWS survey indicate heavy utilization of the habitat. In order to provide the required foraging area for the existing nest sites and territories there should be no significant loss of existing habitat value in Natomas. The Department recommends that the proposed mitigation criteria of at least 0.5 acre protected for each acre lost be the goal of mitigation for Swainson's hawk foraging habitat (see attached draft mitigation guidelines).

The survival of the giant garter snake in the project area will require a commitment by the local sponsors to protect existing snake habitat and to create new channels to replace any that are lost as the result of urban growth. With the loss of nearly 30,000 acres of native habitat and farmland to urban development, specific plans must be implemented to protect essential snake

habitat and to provide buffer from adjacent urban areas. The proposed mitigation plan by the Department for the North Natomas Community Drainage System should be a model for other projects within the Natomas area.

The Department's proposed mitigation plan will replace lost habitat in a desired configuration and will maintain corridors for snake movement and genetic exchange. The proposed mitigation plan will provide protection for the garter snake while allowing substantial development within the project area. This proposed mitigation plan will require minimum maintenance and can be maintained independent of the existing system, if necessary, by providing water from the new canals.

We are developing an overall plan for the giant garter snake within the Natomas area (American Basin) which will incorporate mitigation from this and future developments.

Conclusion

The Department believes that the Natomas area is an essential habitat for the remaining Swainson's hawks in the Central Valley. This species cannot sustain significant losses of nesting and/or foraging habitat as a result of development activity in the region. Until the needed studies are done which will then lead toward a recovery plan for this species, all existing foraging habitat within the vicinity of existing nest sites should be preserved.

Likewise, the Department believes the habitat provided by the present system of irrigation ditches and small canals in Natomas is essential to the continued existence of the giant garter snake. Concurrent with development, an active mitigation program must be in place to preserve the habitat value of the giant garter snake in Natomas (American Basin).

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Mitigation Guidelines for Swainson's Hawks (*Buteo swainsoni*) in the Central Valley of California

CURRENT AND RECOMMENDED MANAGEMENT

The Department of Fish and Game has established the mitigation goal of no net loss of Swainson's hawk breeding or foraging habitat, and has developed the following strategies and mitigation criteria to reverse the dramatic population decline of this species in the Central Valley. These criteria provide guidelines for lead agencies and project sponsors to follow in developing adequate mitigation for the loss of Swainson's hawk habitat. Direction for management towards restoration of this species is also included within this document. These guidelines are to be considered interim and will remain in effect until a comprehensive Swainson's Hawk Habitat Conservation Plan (HCP) is completed by the Department. The scheduled completion date for this plan is Fall 1992. Several HCP's for Swainson's hawk within specific project areas are currently being proposed. These guidelines will be used in conjunction with a Swainson's Hawk Recovery Plan to establish criteria for species recovery through population expansion into former habitat, recruitment of young into the population, and other identified recovery goals. Currently, translocation of active nests will not be considered a viable option to enable development to proceed. Hacking (controlled release) of captive reared young has not been employed to enhance the population at this time.

During project review, the Department will consider whether suitable foraging habitat occurs within a ten (10) mile radius of an active nest and contributes to maintaining that Swainson's hawk breeding territory. This ten-mile radius standard was developed from Department funded telemetry studies. It is considered to be a conservative estimate of the average flight distance from known active nest sites to suitable foraging habitats within the home range of a Swainson's hawk. Therefore, proposed development projects may be required to mitigate impacts at active nest sites and surrounding suitable feeding habitat areas; both of which are essential to the integrity of the breeding territory. In addition, since over 95% of Swainson's hawk nests occur on private land, a program of incentives for the private landowner is needed to ensure that crops which are compatible to the foraging needs of Swainson's hawks are not replaced by incompatible agriculture practices, urbanization, or other land uses.

If you have any questions, please contact Ms. Sherry Teresa, Environmental Services Wildlife Biologist, Region 2, (916) 355-7030, or Mr. Ron Schlorff, Nongame Section, Wildlife Management (916) 322-1261.

LEGAL STATUS

The Swainson's hawk is a migratory bird species protected under the Migratory Bird Treaty Act (MBTA) of 1918 (16 U.S.C. 703-711). The MBTA makes it unlawful to take, possess, buy, sell, purchase, or barter any migratory bird listed in 50 C.F.R. Part 10, including feathers or other parts, nests, eggs, or products, except as allowed by implementing regulations (50 C.F.R. 21). The Swainson's hawk is designated as a Candidate species for listing by the U.S. Fish and Wildlife Service under the federal Endangered Species Act (ESA; 16 U.S.C. 1513-1543). The State of California listed the Swainson's hawk as a Threatened species, thus providing them protection under the California Endangered Species Act [CESA] (Chapter 1.5 Fish and Game Code). In addition, Sections 3503, 3503.5, 3800 of the Fish and Game Code prohibit the take, possession, or destruction of birds, their nests or eggs. The DFG has interpreted the "take" clause in the CESA to include the destruction of either nesting and/or foraging habitat necessary to maintain the reproductive effort. Implementation of the take provisions of the CESA requires that project-related disturbance at active Swainson's hawk territories be reduced or eliminated during critical phases of the nesting cycle (March 1 - August 15 annually). Disturbance that causes nest abandonment and/or loss of reproductive effort (e.g., killing or abandonment of eggs or young) is considered "taking" and is punishable by fines and/or imprisonment. Such taking would also violate federal law protecting migratory birds (e.g., MBTA).

The California Environmental Quality Act (CEQA) requires a mandatory findings of significance if impacts to threatened or endangered species are likely to occur (Sections 21001(c), 21083. Guidelines 15380, 15064, 15065). Avoidance or mitigation must be presented to reduce impact to less than significant levels (See Mitigation Criteria #2.).

NATURAL HISTORY

The Swainson's hawk is a large broadwinged buteo which frequents open county. Approximately the same size as a red-tailed hawk (*Buteo jamaicensis*), but trimmer, Swainson's hawks weigh approximately 800 - 1100 gm. (1 3/4 - 2 lbs) , and have about a 125 cm. (4+') wingspan. The basic body plumage may be highly variable and is characterized by several color phases - light, dark, and rufous. In dark phase birds, the entire body of the bird may be sooty black. Adult birds generally have dark backs. The ventral or underneath sections may be light with a characteristic dark, wide "bib" from the lower throat down to the upper breast. The tail is gray ventrally with a subterminal dusky band, and narrow, less conspicuous barring proximally. The sexes are similar in appearance; females however, are slightly larger than males, as is the case in most sexually dimorphic raptors. There are no recognized subspecies (Palmer 1988).

The Swainson's hawk is a long distance migrator, leaving nesting grounds in northwestern Canada, the western U.S. and Mexico, most populations migrate to wintering grounds in the open pampas areas of South America (Argentina, Uruguay, southern Brazil). This round trip journey may exceed 14,000 miles. The birds will return to the nesting grounds in early March to establish breeding territories.

Swainson's hawks are monogamous and will remain so until the loss of a mate (Palmer 1988). Nest construction and courtship continues through April. The clutch (commonly 3-4 eggs) is laid in early-April to early-May. Incubation lasts 34-35 days, with both parents participating in the brooding of eggs and young. The young leave the nest approximately 42-44 days after hatching (June - July). The young remain with their parents and gain hunting practice until they depart on migration in the fall.

Reproductive Chronology *

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MAR        APR          MAY         JUN        JUL         AUG        SEPT

X-----------X    ARRIVE FROM WINTERING GROUNDS (3/11 - 4/4)
    X-------------X    COURTSHIP AND NEST CONSTRUCTION
          X--------------X    EGGS LAID (4/1 - 5/1)
                          X------X    NESTLINGS FIRST APPEAR (mid-May)
                          X--------------------X    NESTLING STAGE
                                    (mid to late May - early July)
                                             X-----X    FLEDGING (July)
                   (late Aug. - mid- Sept)    MIGRATION X--------X
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* data from J. Estep 1989.

FORAGING REQUIREMENTS

Swainson's hawk nests in the Central Valley of California are generally found in scattered trees or along riparian systems adjacent to agricultural fields or pastures. These open fields and pastures are the primary forage areas. Major prey items for Central Valley birds include: California voles (*Microtus californicus*), valley pocket gophers (*Thomomys bottae*), deer mice (*Peromyscus maniculatus*), California ground squirrels (*Spermophilus beecheyi*), mourning doves (*Zenaida macroura*), ring-necked pheasants (*Phasianus colchicus*), meadowlarks (*Sturnella neglecta*), other passerines, grasshoppers (*Conocephalinae*), crickets (*Gryllidae*), and silphadids (Estep 1989). Swainson's hawks generally search for prey by soaring in open country and agricultural fields similar to northern harriers (*Circus cyaneus*) and ferruginous hawks (*Buteo regalis*). Often many hawks may be seen foraging together following tractors or other farm equipment capturing prey escaping from farming operations. During the breeding season, Swainson's hawks eat mainly vertebrates (small rodents and reptiles), whereas during migration vast numbers of insects are consumed (Palmer 1988).

Department of Fish and Game funded research has documented the importance of suitable foraging habitats (e.g., native grasslands, lightly-grazed pastures, alfalfa and other hay crops, and combinations of hay grain and row crops) within an energetically efficient flight distance from active Swainson's hawk nests (Estep pers. comm.). Recent telemetry studies to determine foraging requirements have shown that birds may require in excess of 15,000 acres of habitat or range up to 18.0 miles from the nest in search of prey (Estep 1989). The area needed for foraging is determined by crop types, agricultural practices, harvesting regimes, prey abundance and availability. Estep (1989) found that 73.4% of observed prey captures were in fields being harvested, disced, mowed or irrigated. Some of the preferred foraging habitats for Swainson's hawks include: (1) Alfalfa - low prey abundance but steady prey accessibility. (2) Fallow fields - high prey abundance and prey accessibility if not dominated by thistle. (3) Beet and Tomato fields - largest prey populations but dense cover reduces prey accessibility, except during harvesting operations when Swainson's hawks have been observed foraging almost exclusively in these fields from late-July to early-September. (4) Dry-land pasture provided the primary forage area for 1 radioed pair, and appears to be an important foraging area. (5) Irrigated pasture provides some forage habitat, especially during flooding. Unsuitable foraging habitat types include any crop where prey are not available due to the high density of vegetation, or have low abundance of prey such as rice fields, vineyards, orchards, and cotton fields.

NESTING REQUIREMENTS

Swainson's hawks nest throughout most of the floor of the Central Valley, although nesting habitat is fragmented and unevenly distributed. More than 85% of the known nests in the Central Valley are within riparian systems in Sacramento, Yolo, and

San Joaquin Counties. Much of the potential nesting habitat remaining in this area is in riparian forests, lone trees, oak groves, and roadside trees. The riparian areas are generally adjacent to and within easy flying distance to alfalfa or hay fields. Department research has shown that valley oaks (*Quercus lobata*), Fremont's cottonwood (*Poplus framontii*), willows (*Salix spp.*), sycamores (*Platanus spp.*), and walnut (*Juglans spp.*) are the preferred nest trees for Swainson's hawks (Bloom 1980, Estep 1989).

HISTORICAL AND CURRENT POPULATION STATUS

The Swainson's Hawk was historically (ca 1900) regarded as one of the most common and numerous raptor species in the state, so much so that they were often not given special mention in field notes. The breeding population has declined by an estimated 91% in California since the turn of the century (Bloom 1980). The historical Swainson's hawk population estimate, based on current densities and estimates of former available habitat, is 4,284 - 17,136 pairs (Bloom 1980). In 1979, approximately 375 ±50 breeding pairs of Swainson's hawks were estimated in California, and 280 (75%) of those pairs were estimated to be in the Central Valley (Bloom 1980). In 1988, 241 active breeding pairs were found in the Central Valley, with an additional 78 active pairs known in northeastern California. The 1989 population estimate was 430 pairs for the Central Valley and 550 pairs statewide. *This difference in population estimates reflect increased survey intensity, not an actual population increase.*

REASONS FOR DECLINE

The dramatic population decline from historic levels has been attributed to loss of native nesting and foraging habitat, and more recently from the conversion of agriculture to urban uses, changes to incompatible crop types and loss of suitable nesting trees. In addition, pesticides, shooting, disturbance at the nest site, and other disturbances on wintering areas may have contributed to their decline. The loss of nesting habitat within riparian areas has been accelerated by flood control practices and bank stabilization programs. Smith (1977) estimated that in 1850 over 770,000 acres of riparian habitat were present in the Sacramento Valley alone. Today less than 12,000 acres of riparian habitat remain. A 98% decrease in riparian vegetation has been documented within the Central Valley (Katibah 1983).

In summary, management needs of the Central Valley population of Swainson's hawks include ensuring the availability of suitable nesting habitat through the 1) preservation and recruitment of suitable nesting trees, 2) protection of existing nesting habitat from destruction or disturbance, 3) maintenance of compatible agricultural practices to preserve forage habitat, and 4) mitigation for loss of breeding and/or foraging habitat. Coordination and cooperation with local agencies must be continued to prevent further habitat destruction from development projects.

MITIGATION CRITERIA

GOAL: NO NET LOSS OF SWAINSON'S HAWKS NESTING OR FORAGING HABITAT

I. Consultation under California Environmental Quality Act (CEQA) and/or California Endangered Species Act (CESA).

1. Project Consultation
Project proponent must consult with the DFG regarding take of an endangered species or its habitat pursuant to Section 2081 of CESA, and appropriate Fish and Game Code Sections.

A. Pursuant to Article 4 of CESA, State agencies are required to consult with the DFG to ensure that any action authorized, funded or carried out by that state agency will not jeopardize the continued existence of any endangered species.

2. CEQA and Subdivision Map Act
Project proponents are encouraged to consult the Department's California Natural Diversity Data Base and Nongame Section to receive updated locational information regarding active Swainson's hawk territories. Due to the complexities of individual cases, it is advisable that developers or others planning projects or actions that may impact one or more Swainson's hawk territories initiate communication with the Department as early as possible.

A. CEQA Guidelines Sec. 15065 directs that a mandatory finding of significance is required for projects that have the potential to substantially degrade or reduce the habitat of, or restrict the range of a threatened or endangered species. CEQA requires agencies to implement feasible mitigation measures or feasible alternatives identified in EIR's for projects which will otherwise cause significant adverse impacts (Sections 21002, 21081, 21083; Guidelines, sections 15002, subd. (a)(3), 15021, subd. (a)(2), 15091, subd. (a).).

To be legally adequate, mitigation measures must be capable of "avoiding the impact altogether by not taking a certain action or parts of an action"; "minimizing impacts by limiting the degree or magnitude of the action and its implementation"; "rectifying the impact by repairing,

rehabilitating or restoring the impacted environment"; "or reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action." (Guidelines, section 15370).

B. Section 66474 (e) of the Subdivision Map Act states "a legislative body of a city or county shall deny approval of a tentative map or parcel map for which a tentative map was not required, if it makes any of the following findings:...(e) that the design of the subdivision or the proposed improvements are likely to cause substantial environmental damage or substantially and avoidably injure fish and wildlife or their habitat". In recent court cases, the court upheld that Section 66474(e) provides for environmental impact review separate from and independent of the requirements of CEQA (Topanga Assn. for a Scenic Community v. County of Los Angeles, 263 Cal. Rptr. 214 (1989).). The finding in Section 66474 is in addition to the requirements for the preparation of an EIR or Negative Declaration.

II. Maintenance of breeding pairs and their habitat.

1. Prevention of disturbance at the nest site.

A. No disturbance should occur within 1/2 mile of an active nest between March 1 - August 15. If the nest tree is to be removed and fledglings are present, the nest tree may not be removed until September 15. If construction or other project related activities which may cause nest abandonment or forced fledging are proposed within this 1/2 mile buffer zone, intensive monitoring (funded by the project sponsor) by a Department approved raptor biologist will be required. Exact implementation of this measure will be based upon specific information at the project site.

2. Prevention of loss of nest trees.

A. Projects should be designed to avoid direct and indirect impacts to nest trees.

B. Revegetation of historical nesting habitat with suitable native nest trees species (e.g., oaks, cottonwoods, sycamores, etc.) adjacent to adequate forage habitat shall

be undertaken.

3. <u>Maintenance of sufficient foraging habitat to support breeding pairs and successful fledging of young.</u>

A. Impact avoidance and project alternatives must be thoroughly analyzed and discussed with DFG representatives prior to adverse modification of foraging habitat as required by CEQA (Section 21002; Guidelines sec.15002, 15021,15126, 21100). This discussion must focus on alternatives capable of either eliminating any significant adverse environmental effect or reducing them to a level less than significant, even if such alternatives would be more costly or to some degree impede the projects objectives.

B. Potential foraging areas are described as identified foraging habitat types located within a 10-mile radius from an active Swainson's nesting territory. Any adverse modification of these foraging areas may require mitigation for loss of foraging habitat. The criteria for assessing this mitigation is as follows:

a. Territory must have been used at least once historically (as determined by DFG Swainson's hawk nesting records).

b. Mitigation will be required for all lands within the defined foraging area (10 miles), excluding the following: Lands which are currently in urban use or lands that have no existing or potential value for foraging Swainson's hawks as determined by site specific surveys by a DFG qualified raptor biologist.

c. Mitigation for foraging areas shall be no less than a 0.5:1 acre ratio (i.e., 0.5 acre replacement for each 1 acre loss of habitat). This ratio is based on the premise that Swainson's hawk foraging habitat values can be at least doubled on mitigation lands through appropriate agricultural plantings, and sound land management practice. Increased mitigation ratios may be necessary in certain instances in order to maintain adequate foraging habitat to support Swainson's hawk populations or if a project site provides breeding or forage habitat for more than one

pair. Habitat conservation plans for several areas are currently being prepared which may identify new information regarding habitat requirements for nesting pairs. Therefore, these criteria are to be considered interim guidelines and mitigation ratios may increase for future projects based on additional information from scientific research on this species.

4. Retention of Habitat

Retain and create sufficient quality habitat to maintain existing population levels and to allow for future population increases to meet recovery goals for the Swainson's hawk (as to be determined by the Swainson's Hawk Recovery Plan).

A. Restoration and enhancement of Swainson's hawk nesting and foraging habitats through the creation and establishment of mitigation banks.

a. Mitigation banks must meet the following minimum criteria:

1. Minimum acreage size of 1,200 contiguous or semi-contiguous acres of undeveloped land. Smaller individual projects may participate in mitigation banks or fee assessment programs to acquire the minimum acreage needed to support a nesting pair.

2. Creation or enhancement of riparian woodlands may be required for some projects. These riparian areas should be not less than 100' wide, with the successful establishment of native riparian species, such as: cottonwoods, oaks, sycamores,and willows. Revegetation plans submitted by the project sponsor shall include but is not limited to the following:

1. Tree densities
2. Species compositions
3. Amount of cover
4. Compensated revegetation for loss due to fire or pests

3. Agriculture practices shall be incorporated into the bank or mitigation area to produce crop types such as but not limited to: alfalfa, dry pasture or native grasslands with little to no grazing, disced fields with hedge rows left approximately every 100 feet, and tomato/beet/row crop fields, or other crops which are compatible for foraging Swainson's hawks.

4. Fee title to land or permanent conservation easements obtained for the Department of Fish and Game, or its designee.

5. Management and operation plans must be incorporated with the mitigation plan and implemented by the project proponent prior to project construction.

6. Project proponent would be responsible for the successful establishment of Swainson's hawk nesting/foraging areas in perpetuity. Monitoring programs will require an annual written review submitted to the DFG for the first 5 years, and thereafter written reviews will be required every 3-5 years for private mitigation projects.

III. Restoration of Swainson's hawk population.

1. Support and acquire funding to continue research related to breeding success, contaminates, dispersal, movement, mortality, habitat use, and other identified research needs. Responsibility: DFG Nongame Bird and Mammal Section.

2. Development and completion of a Habitat Conservation Plan and a Recovery Plan. Responsibility: DFG Nongame Bird and Mammal Section.

3. Coordinate with local agencies for long term planning to maintain sufficient quality habitat for Swainson's hawks. Responsibility: DFG Nongame Bird and Mammal Section and Regional Environmental Services staff.

A. Maintain close coordination with city and county agencies, other state agencies, local agricultural districts, federal agencies, and private conservation organizations to organize a concerted land use plan sensitive to the need of the Swainson's hawk and other listed or sensitive species.

B. Protect and maintain agricultural preserves.

C. Coordinate management planning with responsible agencies.

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DRAFT
11/26/90

CALIFORNIA ENDANGERED SPECIES ACT (CESA)
BIOLOGICAL OPINION
American River Watershed Investigation:
Natomas Area, Sacramento and Sutter Counties

The State Reclamation Board has requested a determination from the California Department of Fish and Game as to whether the proposed American River Watershed Investigation project would jeopardize the continued existence of any State candidate, threatened, or endangered species. Pursuant to sections 2090 through 2093 of the California Endangered Species Act (CESA), the Department of Fish and Game (DFG) has prepared preliminary comments in regard to potential impacts to State-listed species in the Natomas region of the project. These comments are being provided to assist the Reclamation Board at the initial stages of project development.

Project Description

A reconnaissance report for the American River Watershed was completed by the Army Corps of Engineers in January 1988. That study concluded that there are serious flood problems in the Sacramento area, that there are economically feasible solutions to resolve these problems, and that a feasibility scope investigation was warranted. Accordingly, the reconnaissance report included a recommendation that feasibility studies proceed for the mainstrem American River and Natomas areas. A Feasibility Cost Sharing Agreement (FCSA) for the feasibility study was signed between the Corps and non-Federal sponsors made up of the California State Reclamation Board and California Department of Water Resources. An Environmental Impact Statement/Environmental Impact Report (EIS/EIR) is due to be released for this project in November 1990.

Flood protection for the Natomas area would involve raising and strengthening levees. The goal is to protect the approximately 55,000 acre Natomas area bounded by the Natomas East Main Drain and Pleasant Grove Creek Canal on the east, Natomas Cross Canal on the north, Sacramento River on the west and Natomas East Main Drain, Sacramento River and American River on the south (Corps of Engineers 1990). Additionally, areas of Dry Creek, Arcade Creek and the upper 8 miles of the Yolo Bypass could be included as areas of improvement for flood control for a total of over 60,000 acres.

The direct project-related impacts to fish and wildlife resources from levee construction activities will be limited. The Army Corps of Engineers have identified much larger secondary impacts due to growth as a result of land conversion and urbanization in Natomas over the life of the project.

Listed Species:

Swainson's Hawk

The State-listed Threatened Swainson's hawk is a medium-sized

buteo with relatively long, pointed wings and a long, square tail. The wings are bicolored underneath with the wing linings generally lighter than the dark flight feathers. Adult females weigh 28 to 34 ounces and males 25 to 31 ounces.

Swainson's hawks breeding in California spend the winter in South America as far south as Argentina. The diet of the Swainson's hawk is varied with the California vole (Microtus californicus) being the staple in the Central Valley. A variety of birds and insects are also taken. Swainson's hawks require large, open grasslands with abundant prey in association with suitable nest trees. Suitable foraging areas include native grasslands or lightly-grazed pastures, alfalfa and other hay crops and certain grain and row croplands. Unsuitable foraging habitat includes croplands in which prey are scarce or unavailable due to the density of the vegetative cover. Those include vineyards, orchards, rice, corn and cotton crops. Suitable nest sights may be found in mature riparian forest, lone trees or groves of oaks and other species in agricultural fields and mature roadside trees. Over 85 percent of Swainson's hawk territories in the Central Valley are in riparian systems adjacent to suitable foraging habitats.

Swainson's hawks were once found throughout lowland California and were absent only from the Sierra Nevada, north coast ranges and Klamath Mountains and portions of the desert regions of the State. Today, the distribution of Swainson's hawks in California is restricted to portions of the Central Valley and Great Basin regions where suitable nesting and foraging habitat is still available. In the Central Valley, the trend toward planting of more and more crops that are unsuitable for Swainson's hawks (e.g., vineyards, orchards, rice) and urban expansion onto surrounding agricultural and grassland areas further threatens the population. Residential and commercial development of foraging habitat is becoming increasingly prevalent in the center of Swainson's hawk distribution in the Central Valley, particularly in Yolo, Sacramento and San Joaquin counties.

Giant Garter Snake

This is one of the largest garter snakes, with females reaching up to 4 feet total length. It is a dull brown snake with a checkered pattern of well-separated black spots on the dorsal side and a dull yellow mid-dorsal stripe.

The giant garter snake (Thamnophis gigas) is a state threatened species endemic to the Sacramento and San Joaquin valleys where it presently occurs in a clumped distribution from Butte County to Fresno County. It has been extirpated from the San Joaquin Valley south of Fresno County and has recently suffered serious declines in southern Sacramento County. Giant garter snakes in the southern Sacramento Valley inhabit aquatic habitats generally between 10 and 40 feet elevation which are characterized by slow flowing or standing water, emergent vegetation, and abundant

forage species (Pacific treefrogs, bullfrogs, tadpoles, and small fish). They may utilize seasonal water, however, the water must be present during the "summer" (active) season. The presence of elevated natural or manmade features is important to provide refugia in areas subject to winter flooding. Giant garter snakes are generally absent in areas where large, exotic predatory fish,

especially black and striped bass, are well established. They also appear to avoid larger bodies of open water and areas where the banks are only lightly vegetated. Where the option exists, tules are selected over cattails. Giant garter snakes are highly aquatic, apparently avoid areas of dense riparian overstory and usually occur in waterways with mud bottoms and dirt banks. The valley garter snake, Thamnophis sirtalis fitchi, occurs throughout the range of the giant garter snake.

Sacramento Winter-run Chinook Salmon

The State-listed endangered and Federally-listed threatened Sacramento winter-run chinook salmon is a distinct race of chinook salmon (Oncorhynchus tshawytscha). Other races which utilize the Sacramento River are the fall-run, the late fall-run and the spring-run. These races can be distinguished by the timing of adult migration and spawning and the timing of smolt migration. Sacramento winter-run chinook occur only in California and virtually all spawning is limited to the mainstem Sacramento River. Adults migrate past the Red Bluff Diversion Dam (RBDD) on the Sacramento River beginning in mid-December and continuing through July. Most fish spawn upstream of RBDD in May, June, and July with some spawning in early August. Downstream migrant smolts move past Red Bluff beginning in August and continue through October.

The Sacramento winter-run chinook salmon population has declined greatly in recent years. Annual runs for the past five years have averaged about 2,000 fish compared with the 60,000 to 120,000 spawners typical of the 1960s. In 1989, the spawning escapement dropped to 547 fish. Similar numbers of returning fish are reported for 1990.

Project Impacts

The U.S. Fish and Wildlife Service (USFWS) has utilized the Corps of Engineers' land use projections for changes in Natomas as a result of the project to analyze the loss of wildlife habitat over time. Their preliminary figures indicate that substantial wildlife habitat will be lost over the life of the project due to growth and development attributable to increased flood protection. Over one-half (29,750 acres) of the 55,000-acre Natomas area would be converted during the next 50 years. Only 616 acres of conversion result from direct project construction impacts. By the year 2047, a total of 18,500 acres of grainfields, pasture, grasslands, and row crops would be removed from agriculture and converted to other uses (USFWS 1990a).

The habitat and wildlife value of the project site were determined through the Habitat Evaluation Procedures (HEP) analysis, a standard method of determining the values impacted by projects. The USFWS does not attempt to deal with State-listed species and has not included them in their mitigation proposals for fish and wildlife impacts. Neither the DFG nor USFWS uses HEP for endangered species. Therefore, a separate analysis for Swainson's hawk and giant garter snake must be accomplished.

The Corps at its recent Feasibility Report Conference revised its previous position on future land use in Natomas regarding growth inducing impacts as a result of its flood control project. It

will now estimate growth only in so far as it conforms to county and city general plans and projected land use changes through 2010. The result is considerably smaller acreage will be converted attributable to indirect growth-inducing impacts of the flood control project. DFG does not agree with the Corps and the local sponsors that 2010 should be the final date to assess impacts. We believe that an analysis must include those adverse effects that are defined as the "life of the project impacts." this encompasses all permanent changes that are a result of the project, that extend indefinitely into the future, beyond the life of the project itself.

Sacramento Area Flood Control Association (SAFCA) has prepared its own growth analysis for Natomas through 2010 based on existing land and documents. Its figures indicate that over 9500 acres will be taken out of agricultural production in South and North Natomas by 2010. These figures, although less than the projections through 2047, show a significant impact on essential Swainson's hawk foraging habitat in the project area. If the Reclamation Board and the local sponsors wished to show that there were few project related impacts with respect to Swainson's hawk foraging habitat by moving the analysis back to 2010, then it must be concluded that the attempt failed and significant unmitigated losses of essential habitat remain.

The Natomas area reach of the Sacramento River supports one of the highest concentrations of Swainson's hawk nesting territories in California. Monthly reports by the USFWS for Swainson's hawk monitoring of the Sacramento Urban Area Levee Reconstruction Project area have identified 33 territories from the Pocket Area north to Verona (USFWS 1990b). Nesting has been confirmed for most of these territories along with nesting success rates. All confirmed nests are located along the river in mature riparian forest trees. Opportunities to nest away from the river are limited due to the lack of suitable nest trees in Natomas. No survey in the interior of Natomas has been conducted and the only confirmed nesting site not on the Sacramento River is at Fisherman's Lake. As indicated in the discussion of Swainson's hawk biology, the important hunting and foraging areas for Swainson's hawk are agricultural fields surrounding the nest site and can be as far as 18 miles away (Estep 1989). Loss of foraging habitat is a significant impact on the reproductive capability of individual nesting pairs. Protection of this species requires not only preservation of nest trees but also essential foraging habitat nearby. The attached draft mitigation guidelines for Swainson's hawk prepared by the Department's Region 2 office identify the necessary steps toward developing a strategy for protection of foraging habitat.

The giant garter snake will also be threatened by growth-inducing impacts in the Natomas area. The American River Basin, provides the most important habitat remaining in California for this State-listed threatened species. The many connecting irrigation canals, feeder canals, and drains, especially those associated with rice farming, provide habitat and movement corridors for the snake.

These irrigation canals and drains provide approxiamtely 140 miles of giant garter snake canal habitat. In addition, habitat is provided by small irrigation ditches and rice fields in an unknown

amount.

Developments already proposed by the City of Sacramento and Sacramento and Sutter counties could adversely impact approximately 86 miles (60%) of the giant garter snake habitat within the southern American Basin. Proposed flood protection could result in the loss of nearly 30,000 acres of native habitat and farmland to urban development (U.S. Fish and Wildlife Service 1990). Approximately 25 miles of giant garter snake habitat has been recently relocated or otherwise disrupted during the widening of State Route 99/70 (1984-1990).

Loss of rice farming in Natomas would lead to a decline in the amount of water necessary to sustain the snake populations in remaining channels and possibly eliminate their prey base. Resulting urbanization would further degrade the habitat and threaten remaining snakes. The loss of the snake's habitat in the basin and loss of snakes to road kills caused by increased traffic may lead to reclassification of the snake to the endangered species category.

DFG staff have been working with consultants for the City of Sacramento to develop a mitigation plan for their project. The Final EIR for the North Natomas Community Drainage System has not been issued, however, and the DFG anticipates the City will adopt our recommendations to protect the giant garter snake in that portion of Natomas. Combined habitat losses from City sponsored projects and federal sponsored flood control projects could lead to the extirpation of the giant garter snake from its best remaining habitat.

The flood control work in Natomas will not involve any water side construction; therefore, no impacts are anticipated to the Sacramento winter-run chinook salmon as a result of the Natomas area portion of this project.

Conditions to Avoid Jeopardy

The DFG provides the following recommendations in order to avoid jeopardy to the Swainson's hawk and giant garter snake. These recommendations are based on the best available information on the biology of these species. Additional recommendations may be developed pending the completion of the necessary environmental documents for the American River Watershed Investigation and the conclusion of current studies on Swainson's hawk in the project site.

1. No disturbance in the vicinity of the nest trees during the breeding season of March 1 through August 15. Activity that may cause adults to leave the nest and abandon the young would constitute a take. Although 1/2 mile is the rule of thumb for a no activity zone around a nest site, that distance may be modified under certain conditions (i.e., screening by trees if the nest site is across the river from the worksite) with the approval of the Department.

2. All essential foraging habitat in Natomas must be protected or compensated for within the project area. The DFG believes that the Swainson's hawk habitat in Natomas is at or near carrying capacity. The large number of territories

encountered in the USFWS survey indicate heavy utilization of the habitat. In order to provide the required foraging area for the existing nest sites and territories there should be no significant loss of existing habitat value in Natomas.

3. The Reclamation Board shall acquire in fee title and/or secure through the purchase of development rights (conservation easements) a mile-wide strip of agricultural lands in the Natomas Area. These habitat conservation lands shall extend east for one mile from the levee toe of the left bank of the Sacramento River in a continuous band from River Mile 60.7 to River Mile 79. The acquired lands shall remain in agricultural production or be allowed to revert to native habitat subject to the following restrictions: (1) Those crop plants deemed unsuitable by DFG as foraging habitat shall not be planted. (2) Any land use which may be incompatible with the habitat requirements of the Swainson's hawk shall not be permitted. Those areas adjacent to the Sacramento River where barns, houses, or other structures are presently located, as well as those structures are presently located, as well as those agricultural lands where orchards and vineyards are planted, may be unsuitable as Swainson's hawk foraging habitat. In cases where unsuitable lands are located within the mile-wide habitat conservation area, other more suitable lands adjacent to the mile-wide area shall be acquired as replacement on an acre-for-acre basis.

The Reclamation Board may acquire unsuitable lands presently under rice cultivation and through crop rotation convert them to alfalfa, small grains, tomatoes, or other crops of value to the Swainson's hawk for foraging. The one-mile wide band may be modified to accommodate natural features such as canals and other waterways, major roads, and man-made structures. This recommendation is for an average one-mile width which would be desirable to enlarge to include the Fisherman's Lake area with a corresponding decrease elsewhere where less desirable lands are located near the river such as pear orchards or farm houses, barns and outbuildings.

The protection of this mile-wide habitat-foraging area shall be considered the minimum to offset the loss of foraging habitat in Natomas due to growth-inducing impacts that will result from this flood control project.

4. The Reclamation Board shall secure through fee, title or easement the lands described above prior to the initiation of construction of the Flood control project that provides a minimum of 100 year protection to the Natomas Area. Those lands may be managed by DFG or another agency or conservation organization acceptable to DFG. Those lands under conservation easement, which runs with title of the land will remain in private ownership. Landowners may continue to farm subject to the restrictions contained within the easement.

The Reclamation Board must make a serious effort to Obtain all necessary lands as soon as possible prior to construction. DFG will not issue a jeopardy opinion i_ they are acting in good faith to obtain the necessary purchases and agreements, but have not completed the process prior to construction. The Reclamation Board in the PDFG shall enter into a Memorandum of

Understanding for this purpose.

If DFG or a third party is to manage the mitigation lands a permanent operations and maintenance budget must be made part of the mitigation agreements. Land in close proximity to a rapidly-growing urban center has special needs for law enforcement, trash removal, fencing etc.

5. The Reclamation Board shall develop in coordination with local lead agencies, DFG, and U.S. Fish and Wildlife Service a comprehensive plan for habitat protection and conservation in the Natomas Area. This plan shall provide protection to the giant garter snake, Swainson's Hawk, and the valley elderberry longhorn beetle with the goals of "no net loss" of essential habitat for those species. The plan would also allow for planned development in those areas deemed not suitable habitat and not restorable or important to the integrity of the conservation area, while providing a comprehensive mitigation plan to compensate for development which may occur on land considered habitat and utilized by these species.

6. The Swainson's Hawk habitat conservation lands acquired by The Reclamation Board may also be used, subject to DFG approval, as a mitigation bank for private development in Natomas. The implementation of the Natomas Conservation Plan will provide a mechanism by which developers may buy into the preserved lands to offset project impacts to Swainson's Hawk foraging habitat. Developers would not be required to participate in the program, but would never the less have to find suitable lands in Natomas as mitigation for their projects.

Since The Reclamation Board would be protecting land that would otherwise be lost due to growth in Natomas, if the local agencies who make land use decisions act responsibly to protect foraging habitat and require mitigation for development, they may buy into the protected lands as a mitigation bank. The Reclamation Board shall hold these lands available until such time as individual project sponsors purchase mitigation credits in them. the Reclamation Board may therefore be compensated for their purchase of the habitat conservation lands by the local sponsors who receive the benefits of the flood control project. Once the credits in the mitigation bank have been completely allocated, that does not relieve the local lead agencies or project sponsors of further mitigation for future projects. Other suitable lands must be found or made suitable as foraging habitat for Swainson's Hawk within Natomas. The ultimate size of the habitat conservation lands in addition to the Reclamation Board designated areas will depend on the amount of future development in Natomas. The procedures for protecting lands shall be outlined in the Natomas Habitat Conservation Plan.

7. The survival of the giant garter snake in the project area will require a commitment by the local sponsors to protect existing snake habitat and to create new channels to replace any that are lost as the result of urban growth. With the loss of nearly 30,000 acres of native habitat and farmland to urban development, specific plans must be implemented to protect essential snake habitat and to provide buffer from adjacent urban areas.

Buffers between giant garter snake habitat and urban development should extend at least 100 ft from the outside edge of the giant garter snake habitat (levee toe or maintenance road) to a boundary fence. The buffer should consist of at least 75 ft of native or ruderal vegetation with 15-25 ft of bare ground along the boundary fence. The bare ground area could be used for a bikeway. Narrower buffers would be acceptable between giant garter snake habitat and agriculture, and the buffer width would depend upon the particular crop and farming practices. Giant garter snake habitat should be separated from roads with a minimum 30-ft buffer between the giant garter snake habitat and the outside edge of the road right-of-way.

Conceptually, a preservation plan for the giant garter snake, within the southern American Basin, would consist of a minimum of one core habitat within each of the three main habitat

areas with connecting canals to provide for movement of giant garter snakes between and within the three areas.

Area 1 (west of State Route 99/70, north of I-5)

Habitat for giant garter snakes could be enhanced here by providing rice fields or shallow tule marshes to provide additional summer foraging habitat adjacent to Prichard Lake. The northern end of the SMF property could be enhanced to provide such habitat. The main movement corridors and canal habitat include the North Drainage Canal, East Drainage Canal, and the Powerline Road and Lone Tree Road ditches. The Powerline Road ditch could be improved to provide a more direct connection south to the West Drainage Canal. The ditches on the west side of SMF could also be enhanced to increase their suitability as GGS habitat. An agricultural preserve for rice farming, in the area bordered by Elverta Road, Powerline Road, Riego Road, and State Route 99/70, including the canal and ditch system, would help insure the survival of the giant garter snake in Area 1.

Area 2 (south and west of I-5, north of I-80)

If the North Natomas Community Drainage System (NNCFS) is aporoved and the Del Paso Canal is built, additional giant garter snake ditch habitat will be constructed paralleling and hydraulically connected to Fishermans Lake on the west. If the Del Paso Canal is not built, the west side of Fishermans Lake would still be an acceptable area for giant garter snake mitigation habitat. Another area for potential enhancement/mitigation habitat would be south of I-5 and adjacent to the West Drainage Canal, west of Lone Tree Road. The main canal habitat/movement corridors occur along the West Drainage Canal, Powerline Road ditch, and Lone Tree Road ditch.

Area 3 (east of State Route 99/70 and I-5, north of I-80)

This is on- of the most important giant garter snake areas and is probably the most vulnerable to loss or deegradation. The North Main Canal (Snake Alley) and associated rice fields support the largest known concentration of giant garter

snakes within the Basin. We propose that the North Main Canal, and some of its associated rice fields, be preserved for giant garter snake habitat.

This area would be suitable for providing a bikeway along the North Main Canal between Elverta Road and Sankey Road. Such a bikeway could be extended south to Elkhorn Boulevard along the East Drainage Canal to connect with the bikeway prposed for the NNCDS. Commercial businesses could be developed at or near the intersections of Elverta, Riego, and Sankey Roads with State Route 99/70, provided that rice fields remain between those areas, and the canal systems are not disrupted.

The southern portion of the area encompasses the proposed NNCDS. Conceptual mitigation for the giant garter snake has already been proposed for this area (Jones and Stokes 1989). If the NNCDS is not built, mitigation for the loss or degradation of giant garter snake habitat will have to be re-evaluated.

Conclusion

The DFG believes that the Natomas area is an essential habitat for the remaining Swainson's hawks in the Central Valley. This species cannot sustain significant losses of nesting and/or foraging habitat as a result of development activity in the region. Until the needed studies are done which will then lead toward a recovery plan for this species, all existing foraging habitat within the vicinity of existing nest sites should be preserved.

Likewise, the DFG believes the habitat provided by the present system of irrigation ditches and small canals in Natomas is essential to the continued existence of the giant garter snake. Concurrent with development, an active mitigation program must be in place to preserve the habitat value of the giant garter snake in Natomas (American Basin).

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Works Flood Control and Sewer Division. 243 pp. + appendices.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Fish and Wildlife Enhancement
Sacramento Field Office
2800 Cottage Way, Room E-1823
Sacramento, California 95825-1846

In Reply Refer To:
1-1-I-91-985

October 4, 1991

District Engineer
Environmental Planning Branch
Attention: Mr. Mike Welsh
U.S. Army of Engineers
1325 J Street Fourteenth Floor
Sacramento, California 95825

Subject: American River Watershed Investigation and the Threatened Valley Elderberry Longhorn Beetle

Dear Sir:

This letter concerns the formal consultation under Section 7 of the Endangered Species Act of 1973, as amended, initiated by the U.S. Army Corps of Engineers (Corps) for the American River Watershed Investigation and the threatened valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) (beetle). The U.S. Fish and Wildlife Service recommends that the Corps hold this consultation in abeyance until the following information is determined by your agency: 1) the specific project that will be proposed by the Corps as requested in our September 27, 1991, letter; 2) A quantification of the direct and indirect impacts to the beetle resulting from the project's construction and operation; and 3) the specific mitigations that the Corps would undertake to offset adverse impacts to the beetle.

We would appreciate written notification of your intent on this matter. Please contact Chris Nagano of my staff at 916/978-4866 or FTS 460-4866 if you have any questions.

Sincerely,

Wayne S. White
Field Supervisor

cc:

ARD (AFEW), FWS, Portland, OR
SFO-WR, Sacramento, CA

October 15, 1991

Environmental Resources Branch

Mr. Wayne S. White, Field Supervisor
U.S. Fish and Wildlife Services
2800 Cottage Way
Sacramento, California 95825-1845

Dear Mr. White:

This is in response to your letter of September 27, 1991, requesting identification of the specific flood control project for the American River Watershed Investigation to be evaluated. We are requesting formal consultation on the proposed project identified as the 200-year Alternative. A summary of project features, impacts, and proposed mitigation is attached.

Your letter also addressed concerns regarding impacts to the elderberry longhorn beetle (Desmocerus californicus dimorphus). No direct impacts to the beetle are expected as a result of the selected plan. Direct impacts to the beetle would result from the 100-year (FEMA) and 150-year alternatives which would involve changes in the river's flow regime which could adversely impact vegetation within the American River Parkway, including critical beetle habitat. The degree to which altered flow would affect the elderberry plants is not known.

Please contact Mike Welsh (557-6718) or Donna Stanek (557-6752) of my staff if you have any questions.

Sincerely,

Walter Yep
Chief, Planning Division

Attachment
cc:
Plng Div
ERB

October 25, 1991

Environmental Resources Branch

Mr. Wayne S. White, Field Supervisor
U.S. Fish and Wildlife Service
2800 Cottage Way
Sacramento, California 95825-1845

Dear Mr. White:

Recently we requested and received from your office a copy of the Federal Register with the proposed rule for listing the delta smelt (Hypomesus transpacificus) as a threatened species. We are in need of some additional information, specifically whether or not the delta smelt occurs in the American River Watershed Investigation project area. The study area has been identified as the American River drainage basin plus flood-prone areas immediately downstream. (See enclosed map.)

Please contact Mike Welsh at (916) 557-6718 or Donna Stanek at (916) 557-6762 of my staff if you have any questions.

Sincerely,

Walter Yep
Chief, Planning Division

Enclosure

cc:
Plng Div
ERB

November 22, 1991

Environmental Resources Branch

Mr. Wayne S. White, Field Supervisor
Fish and Wildlife Service
Fish and Wildlife Enhancement
2800 Cottage Way, Room E-1823
Sacramento, California 95825-1846

Dear Mr. White:

I am providing the information you requested in your letters of September 27 and October 4 concerning the American River Watershed Investigation (ARWI). I am also supplementing our previous biological assessment on the threatened valley elderberry longhorn beetle (VELB), as explained below.

The revised selected plan is the 200-Year flood control dam alternative which was described in the Draft EIS/EIR (DEIS/EIR) dated April 5, 1991. This alternative has the same basic impacts as the 400-Year alternative described in detail in the DEIS/EIR, except that there would be slightly less fill placed on the levees in the Natomas area and the detention dam would be 425 feet tall instead of 495 feet. This reduction in dam height has reduced the temporary storage capability from 894,000 acre-feet to 545,000 acre-feet covering a maximum of 4,000 acres for no more than 20-days during a 200-year event. The aggregate required to construct the dam will be obtained from an existing quarry located near Cool in El Dorado County, and transported to the dam site on a conveyor system.

Recent information provided informally by Chris Nagano of your staff reveals that although the elderberry shrub has been known to occur in the detention dam area, you now believe that the VELB inhabits shrubs at these elevations. It is requested that you officially advise us in writing whether or not the VELB is known to occur in the vicinity of the proposed dam and inundation area. Assuming that the VELB does occur in the detention dam area, it is our biological assessment that there is the likelihood of adverse impacts on the VELB and formal consultation is requested supplementing our previous request.

Our schedule calls for completing the EIS/EIR on the ARWI next month. In order to maintain our schedule in light of this recent information and assuming you confirm the elderberry shrubs in the detention dam area provide habitat for the VELB, we will include an estimate of impacts and mitigation in the EIS/EIR. Following project authorization, we will confirm the mitigation requirement after conducting detailed field investigations.

Construction and operation of the project in the Natomas area will not affect elderberry shrubs. There is no mitigation requirement for direct impacts to VELB in the Natomas area. However, there will be elderberry shrubs mixed into the planting mix used to compensate for impacts to riparian vegetation resulting from construction activities in the Natomas area. The 255-acre mitigation area will consist of a combination of wetland and upland riparian habitats. Elderberry shrubs will also be incorporated into the planting mix of native plants which will be used to revegetate the conveyor system alignment, the concrete processing and mixing plant sites, access roads, and disposal areas after construction is completed. As part of the operation and maintenance of the project, areas which are affected by slides or sloughing after flood events will be planted with suitable native species (including elderberry shrubs as appropriate).

The Natomas basin was surveyed to determine the location of elderberry shrubs which may be affected by development in the future. As described in the survey results attached, the elderberry shrubs that do occur in the Natomas area are generally found near the landside of the levee along the Sacramento River. The sixteen locations of elderberry shrubs identified generally occur as single shrubs except for those which are growing in a small field located at the intersection of Northgate Boulevard and the Garden Highway. This area contain as many as 20 small shrubs scattered in clumps. Many of these shrubs are located in areas which are not proposed for development under the adopted local plans. Incorporating elderberry shrubs into the planting mix for the mitigation area should provide sufficient compensation for future impacts to elderberry shrubs in the project area.

If you have any questions in this matter, please contact Michael Welsh at (916) 557-6718.

Sincerely,

Walter Yep
Chief, Planning Division

Attachments

Valley Elderberry Longhorn Beetle Distribution and Habitat Survey for the Interior Natomas Area

Introduction

The survey was conducted to determine the location elderberry shrubs within the interior of the Natomas basin. This survey involved mapping the occurrence and distribution of elderberry shrubs throughout the basin. The information obtained from this field survey will assist in determining the possible effects of future development (which will result from the proposed flood protection project) on the threatened valley elderberry longhorn beetle.

Survey Discussion

With the size of the study area being roughly 55,000 acres, the abundance of streets and dirt roads made it possible to do a thorough search to locate and map the location of existing shrubs. Aerial photographs with a scale of 1" to 400' were used to map the location of elderberry shrubs found during the survey.

The method of search employed was to simply drive the entire study area and look for elderberry shrubs. In some places the survey team walked the levees in the southeast portion of Natomas as well as a portion of the East Main Drain and Cross Canal. In some of these areas and some internal areas, binoculars were used to determine if elderberry shrubs existed in inaccessible locations. Not only was the location of the shrubs determined, but the type of other vegetation associated with the shrubs was also noted.

Results

A map of the Natomas basin showing where elderberry shrubs were found is attached. It is a very small scale in order to reveal the information obtained from the study.

The study revealed that elderberry shrubs were not found to occur within the interior of the Natomas area. This included the Natomas Cross Canal and the Natomas East Main Drain. However, the elderberry shrubs that were found occurred mostly on the landside of the Sacramento River levee. The shrubs occurred in this way:

1. A multi-stem elderberry shrub growing within a heavily vegetated area. Bush approximately 400 feet from Highway

2. Elderberry habitat occurs at 2 miles North of San Juan on Garden Highway. Bush was a multi-stem shrub and was found growing with other vegetation. Area was heavily vegetated.

3. A small multi-stem shrub found at about one-third of a mile from Powerline on Garden Highway(G.H). Shrub is off to the right hand side of the road-can be seen from G.H. Area is heavily vegetated.

4. Another very small single-stem elderberry was found about 0.1 mile from the shrub described in 3 above.

5. A small multi-stem was found growing with other small shrubs at about 0.2 miles north of the shrub described in 4 above.

6. A single stem elderberry shrub was found about 1.5 miles north of Powerline Road. The shrub was growing by itself.

7. A small multi-stem shrub was found at about 3.0 miles north of Powerline Road. The shrub was located about 100 feet from Garden Highway on the south side of the irrigation canal. This area was heavily vegetated.

8. A small multi-stem elderberry was located 0.2 miles north of I-5. The shrub occurred 50 yards east of Garden Highway near a house. The shrub was growing in its backyard, along with ornamental shrubs.

9. A large multi-stem shrub occurred about 1.8 miles north of Elkhorn Road adjacent to a dirt road about 100 feet east of Garden Highway. The area was heavily vegetated and heavily traveled by large trucks.

10. Another multi-stem shrub was found growing in a field alone with a large oak tree at about 0.5 miles north of Elverta Road.

11. A multi-stem shrub was found growing in a field about 2.7 miles north of Elkhorn Road. It had heavy vegetation growing near it.

12. A multi-stem shrub was found about 1.5 miles north of Riego Road on Garden Highway growing in a stand of trees and shrubs.

13. A large multi-stem shrub was found about 100 feet north of Sankey Road. There was not much vegetation nearby except for small shrubs.

14. A small field to the southwest of the intersection of Northgate Boulevard and Garden Highway contains

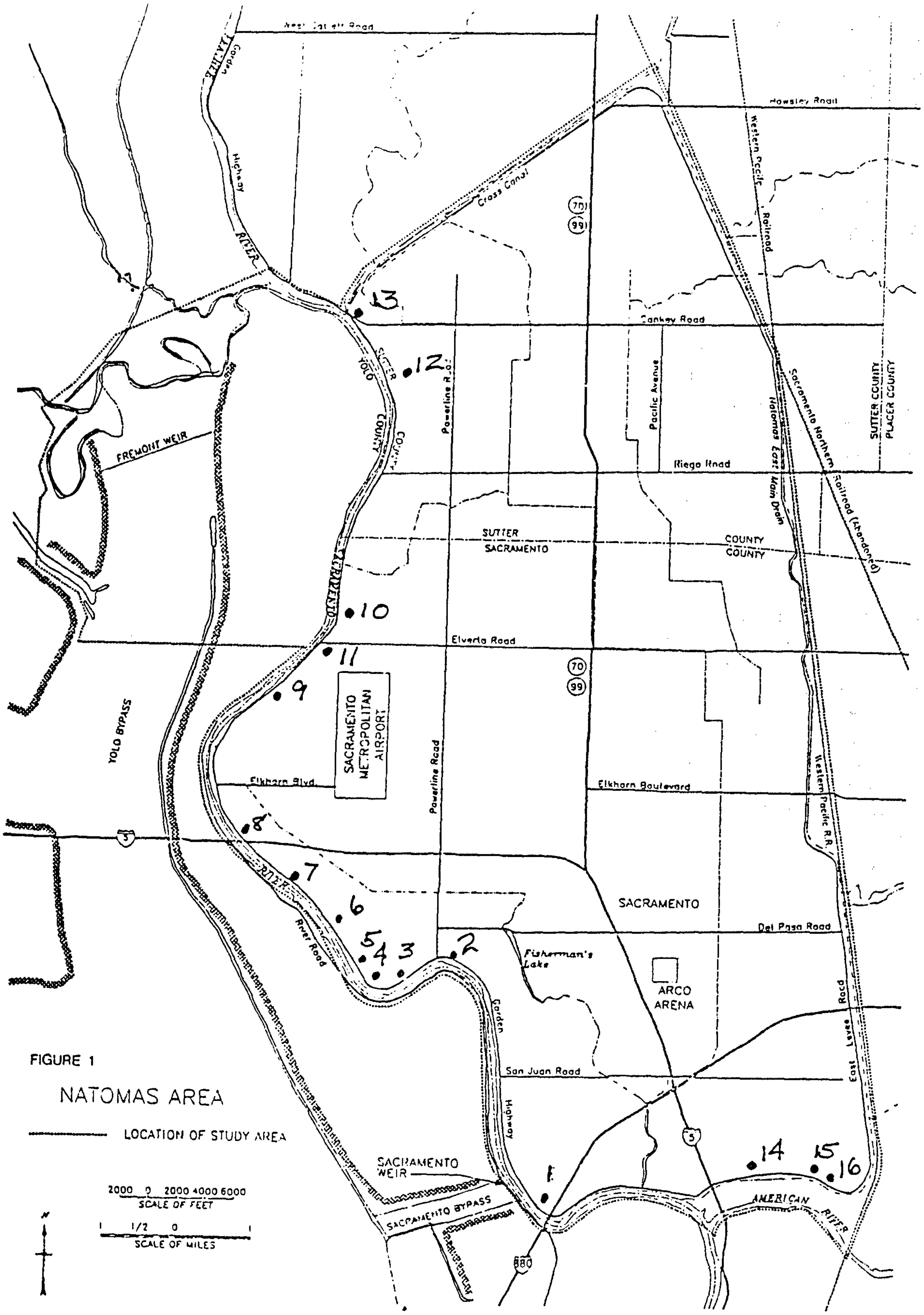
approximately 15-20 multi-stem shrubs. The only other vegetation that inhabited this field was some trees and other small shrubs.

15. A small multi-stem shrub was found near East Levee Road about 100-yards from Northgate Boulevard. Vegetation in the area was quite abundant.

16. A small multi-stem shrub was found on East Levee Road about 150-200 yards east of Northgate Boulevard with abundant vegetation surrounding it.

Discussion

The survey located 16 shrubs or groups of shrubs that can possibly be areas in which the Valley Elderberry Longhorn Beetle may live. The areas can be seen on the small map attached. If a larger scale is needed, 1" to 400' scale maps are available in the Environmental REsources Branch.



LOCATION OF ELDERBERRY SHRUBS
IN NATOMAS BASIN

United States Department of the Interior

TAKE PRIDE IN AMERICA

FISH AND WILDLIFE SERVICE
Fish and Wildlife Enhancement
Sacramento Field Office
2800 Cottage Way, Room E-1823
Sacramento, California 95825-1846

In Reply Refer To:
1-1-91-TA-976

September 27, 1991

District Engineer
Environmental Planning Branch
Attention: Mike Welsh
U.S. Army Corps of Engineers
1325 J Street 14th Floor
Sacramento, California 958143-2922

Subject: Threatened Valley Eldberberry Longhorn Beetle and the American River Watershed Investigation

Dear Sir:

This letter is in response to your request for formal consultation on the American River Watershed Investgation. The U.S. Army Corps of Engineers (Corps) presented information to the U.S. Fish and Wildlife Service (Service) that indicates that the threatened valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) may be adversely impacted by the project. The Corps did not identify the proposed action to be addressed in the consultation. Under 50 CFR §402.14(a), Federal agencies must initiate formal consultation on a specific proposed project not alternatives. We, therefore, request that the Corps identify the specific flood control project for the American River Watershed Investigation to be evaulated including the mitigation actions to be undertaken for any adverse impacts to the beetle.

Please contact Chris Nagano of my staff at 916/978-4866 if you have questions.

Sincerely,

for Wayne S. White
Field Supervisor

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Fish and Wildlife Enhancement
Sacramento Field Office
2800 Cottage Way, Room E-1823
Sacramento, California 95825-1846

In Reply Refer To:
1-1-91-F-20

November 27, 1991

Colonel Laurence R. Sadoff
Environmental Resources Branch
U.S. Army Corps of Engineers
1325 J Street
Sacramento, California 95814

Subject: Biological Opinion on the Formal Section 7 Consultation for the American River Watershed Investigation, California

Dear Sir:

This responds to your May 6, 1991, request for formal consultation pursuant to Section 7 of the Endangered Species Act of 1973, as amended (Act). At issue are the effects of the American River Watershed Investigation on the federally listed threatened valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) (beetle) and its elderberry (*Sambucus* species) habitat.

Your request for consultation was received on May 13, 1991. This office requested additional required information on September 24 and 27, 1991, and October 4, 1991. The requested information from your office, dated October 15, 1991, was received on October 18, 1991. Additional information on the mitigation for the proposed project was provided in your letter dated November 22, 1991. This formal consultation is based on the letters and associated material from your office, a meeting between Mike Welsh of your office and Chris Nagano of my staff on July 16, 1991, and November 4, 1991, a meeting between Mike Welsh and Peggie Kohl and Chris Nagano of my staff on September 11, 1991, a telephone conversation between Charles Baad of your office and Chris Nagano on September 25, 1991, and telephone conversations between Chris Nagano and Mike Welsh of your office on November 8, 1991 and November 20, 1991.

Biological Opinion

It is our biological opinion that construction and operation of the proposed 200-year American River Watershed Investigation project alternative, including the mitigation for the beetle, as described in this biological opinion, is not likely to jeopardize the valley elderberry longhorn beetle and is not likely to result in destruction or adverse modification of its critical habitat. Although critical habitat has been designated for the beetle, none will be adversely affected by the proposed project.

Description of the Proposed Action

Please refer to the following documents for a detailed description of the proposed project: 1) *Draft American River Watershed Investigation, California Feasibility Report, Part I Main Report, Part II Draft Environmental Impact Statement/Environmental Impact Report;* and the accompanying *Documentation Report, volume 3-Appendixes N-Q* (DEIS) prepared by the Sacramento District of the U.S. Army Corps of Engineers and dated April 1991; 2) *CE-American River Watershed Investigation, Draft Report on the Distribution and Habitat for the Valley Elderberry Longhorn Beetle in the Study Area* (Study) prepared by the Sacramento Field Office of the U.S. Fish and Wildlife Service and dated April 2, 1991; 3) *Draft American River Watershed Investigation, Lower American River, substantiating report; Auburn Area, substantiating report and appendices* (Investigation) prepared by the Sacramento Field Office of the U.S. Fish and Wildlife Service and dated February 1991; and 4) *Existing and Proposed Land Uses of Alternative Mitigation Lands* (Report) by the Realty Division of the Sacramento District of the U.S. Army Corps of Engineers, dated November 9, 1991.

In brief, the proposed project was developed based on studies on flooding problems along the American and Sacramento Rivers in the greater Sacramento Area by the U.S. Army Corps of Engineers (Corps). A number of alternatives for flood protection to lands within the American River watershed at 400, 200, 150 and 100 year intervals were presented in the DEIS. The alternatives would involve various combinations of flood controls. The material supplied by the Corps in letter dated October 15, 1991, requested formal consultation on the 200-year project alternative (project). According to the DEIS, this would include setting the Folsom Dam release and American River capacity to 115,000 cubic feet per second, raising/replacing the bridge at Ponderosa Way and Main Avenue, raising the Yolo Bypass levees, raising/constructing new levees in Natomas, lengthening Fremont Weir for 1000 feet, building a dam at Auburn (Dry Dam) with a height of 415 feet and a storage capacity of 545,000 acre feet, relocating Highway 49 in the Dry Dam area, and constructing recreation trails in Natomas.

The beetle habitat on the North Fork American River and Middle Fork American River behind the Dry Dam would be inundated during a 200-year event, based on the Study and discussion of other fish and wildlife issues between the Corps and the Service. The letter from your office dated November 22, 1991, indicated that this area could be covered for a short period or a time period of not more than 20-days.

To offset adverse impacts to the beetle and its habitat, the Corps has developed a mitigation plan. This plan includes the following mitigations:

1. Acquisition of fee-title to 2,700 acres of the South Fork American River above referenced in the November 9, 1991, report.

2. Planting of 32,336 elderberry shrubs in the 2,700 acres on the South Fork American River.

3. Maintaining and monitoring the 2,700 acres for three years and at the end of that period, the non-Federal sponsor will be responsible for assuring the success of all mitigation areas for the life of the project.

4. Revegetating of areas behind the Dry Dam eliminated by landslides during 200-year flood events.

Species Account/Environmental Baseline

The valley elderberry longhorn beetle is dependent on its host plant, the elderberry shrub (*Sambucus* sp.). The beetle ranges from Redding to the Bakersfield area and from the west slope of the Sierra Nevada to the east slope of the Coast Range in California. Adult specimens have been found from the valley floor to an altitude of 2,700 feet in the western foothills of the Sierra Nevada. Exit holes made by the beetle have been found in the Auburn area of Placer County. Use of elderberry plants by the animal, a wood borer, is rarely apparent. Frequently, the only exterior evidence of the shrub's use by the beetle is an exit hole created by the larvae prior to the pupal stage. Our June 28, 1984, Valley Elderberry Longhorn Beetle Recovery Plan contains further details on the beetle's life history.

The study documents the occurrence of 16,945 acres of beetle habitat in the project area. Many of the elderberry shrubs in the project area show evidence of use by the beetle, i.e, emergence holes. In addition, adult beetles have been observed on numerous instances on the American and Sacramento Rivers in Sacramento County. Thus, all elderberry shrubs with a stem diameter of one inch or greater in the project area are considered to be habitat for the animal. Suitable habitat was classified as follows: Category 1-elderberry shrubs common to abundant, clumps of shrubs commonly present, typically ranging in abundance from >5 to many shrubs per acre; Category 2-elderberry shrubs common to infrequent, ranging from >1 shrub per acre to 5 or more per acre; and Category 3-elderberry shrubs infrequent to rare, frequently sparse, isolated or widely scattered often single shrubs typically <1 shrub per acre. There are 1108 acres of category 1 habitat, 3,872 acres of category 2 habitat, and 11,965 acres of category 3 habitat in the project area. Exit holes made by the threatened valley elderberry longhorn beetle are located in a number of these plants.

Effects of the Action

According to the DEIS, the Study, and the Investigation, 3,900 acres of habitat for the threatened valley elderberry longhorn beetle above the Dry Dam would be lost over the life of the project as a result of flooding, inundation, landslides, and other associated impacts.

Our analysis indicates that the Natomas portion of the proposed project is not likely to result in any take of the beetle. Although beetles are found from the site of the Dry Dam to the mouth of the American River, it is unlikely

that any take will result as a result of impacts from the proposed project. The planting of elderberry shrubs and associated native vegetation in the Natomas East Main Drain area, as described in your letter of November 22, 1991, may benefit the long term survival and recovery of the beetle.

The U.S. Fish and Wildlife Service has developed compensation guidelines for the valley elderberry longhorn beetle (USFWS 1988) that recommend measures to offset adverse impacts to the species and its habitat. Copies of these guidelines were provided earlier to your staff. The Corps has measured the amount of beetle habitat on the North Fork American River and Middle Fork American River above the Dry Dam that will be adversely affected by a 200-year event. The letter indicates that there are 601 acres of Category-1 habitat, 1,739 acres of Category-2 habitat, and 1,660 acres of Category-3 habitat. There are approximately 3,005 shrubs in the Category-1 habitat area, 5,217 shrubs in Category-2 habitat area, and 1,660 in Category-3 habitat area. For the Category-1 habitat, the Corps will be mitigating at a ratio of five elderberry shrubs for every one lost (15,025 shrubs), three to one or 15,651 shrubs for Category-2 habitat, and one to one or 1,660 shrubs for the Category-3. Thus a total of 32,336 elderberry shrubs will be planted at the mitigation area on the South Fork American River.

Based on the foregoing analysis, the proposed project is not likely to significantly reduce the population size of the threatened valley elderberry longhorn beetle and thus reduce the likelihood of its survival and recovery nor will it result in adverse modification or destruction of critical habitat.

Cumulative Effects

Cumulative effects are those impacts of future State, local and private actions affecting endangered and threatened species that are reasonably certain to occur in the action area. This area in the Sacramento Valley is being developed, primarily by private parties for residential and commercial development. However, actions of which we are aware of at this time together with those addressed in this Biological Opinion are not expected to appreciably reduce the likelihood of the survival and recovery of the valley elderberry longhorn beetle.

Incidental Take

Section 9 of the Endangered Species Act prohibits any taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct) of listed wildlife species without special exemption. Under the terms of Section 7(b)(4) and 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered prohibited taking within the bounds of the Act provided that such taking is in compliance with this Incidental Take statement. The measures described below are not discretionary, and must be undertaken by the action agency or the project sponsor, as appropriate.

Proposed project actions that may result in the death or injury of listed species have been previously discussed in this Biological Opinion. There is no way to estimate the number of beetle larvae contained within each elderberry. From recent field work on the Cosumnes River and the Folsom Lake area, we know that larvae galleries can be found in stems with no evidence of emergence holes (either the larvae succumb prior to constructing the emergence hole or they have not come far enough along in the developmental process to construct their hole). Larvae appear to be distributed in stems 1.0 inches or larger in diameter at ground level. Because we do not know how many larvae each stem can support, we cannot simply multiply the number of stems by a given number to estimate the number of beetles present. In addition, due to the substantial acreage inhabited by the beetle that will affected by the proposed project and the extreme difficulty of survey this area, we present the estimate of incidental take of the beetle in terms of the number of elderberry plants or acreage containing beetle habitat that will be lost. Based on the available information, the Service anticipates that all valley elderberry longhorn beetles inhabiting all elderberry shrubs with a stem diameter of one inch or greater on 3,900 acres above the Dry Dam along the North Fork American River and Middle Fork American River identified in the Study will be taken as a result of the implementation of the project.

The following reasonable and prudent measures are necessary and appropriate to minimize the take:

1. Loss of valley elderberry beetle habitat on the North Fork American River and Middle Fork American River shall be compensated for prior to construction of the 200 year flood control alternative of the American River Watershed Investigation.

2. Measures shall be implemented to insure the success of the mitigation and maintain the mitigation site as valley elderberry beetle habitat in perpetuity.

In order to be exempt from the prohibitions of Section 9 of the Act, the following terms and conditions, which implement the reasonable and prudent measure described above, must be complied with:

1) The Corps shall acquire fee title for compensation habitat on the South Fork American River for the valley elderberry longhorn beetle.

   a. At least twelve (12) months prior to the initiation of construction of the project, the Corps shall acquire fee title for 2,700 acres of valley elderberry beetle habitat along the South Fork American River. The lands shall be specifically designated as valley elderberry beetle habitat. If fee title is given to an appropriate resource agency or conservation organization, the Service must concur with the transfer.

2. Measures shall be implemented to insure the success of the mitigation and maintain the mitigation sites as valley elderberry beetle in perpetuity.

a. Elderberry seeds for the plantings on the South Fork American River shall be taken from native populations along the American River or the immediate vicinity. Saplings shall be utilized in the restoration areas. Approval of the Service is required for the donor sites.

b. Recent studies have found that beetles were more abundant in more dense native plant communities with a mature overstory and mixed understory versus a low overstory and young understory. Therefore, a mix of native riparian trees including cottonwood (*Populus fremontii*), white alder (*Alnus rhombifolia*), and oak (*Quercus agricolia* and *Q. lobata*) shall be planted at a ratio of at least two of these species for every five elderberry shrubs (64,672 plants total). These plantings also shall be monitored with the same survival criteria utilized for the elderberry plants. The saplings shall be from native populations on the American River or from the immediate project vicinity. The approval by the Service of the native plant donor sites shall be obtained prior to initiation of any of the revegetation work.

c. A planting plan for the mitigation area on the South Fork American River shall be developed by the Corps within twelve (12) months of the date that construction is begun. It shall be approved by the Service prior to its implementation.

d. Cattle and other livestock that feed on elderberry shrubs and other native vegetation shall be excluded from the mitigation area on the South Fork American River.

e. A qualified biologist(s) shall review all aspects of the mitigation plan. The biologist(s) utilized shall be subject to the approval of the Service.

f. Personnel from the Service shall be given access to the mitigation site in perpetuity to monitor implementation and success of the mitigation plan.

g. A minimum of 80 percent of the original 32,336 elderberry shrubs planted in the mitigation area on the South Fork American River must be alive ten years from the date the mitigation program is implemented. If this survival rate is not met, the Corps shall reinitiate formal consultation with the Service.

h. The population of the adults of the threatened valley elderberry longhorn beetle and the general condition of the mitigation site on the South Fork American River shall be monitored annually for the life of the project by a qualified

entomologist. Two visits between February 14 and June 30 of each year shall be made beginning the year the mitigation is begun. The study shall include a population census of the adult beetles, including the actual number of animals observed, their condition, behavior, and precise location at the site; a census of the elderberry plants, including the number of plants observed and their size, and condition; and a general assessment of the habitat, including any real or potential threats to the beetle, its food plants, such as erosion, excessive grazing by livestock, off-road vehicle use, etc. Random-walk counts shall be used; mark-recapture or other methods that involve handling or harassment shall not be utilized. The materials and methods that will be utilized for this study shall be reviewed and approved by the Service. All appropriate Federal and State permits shall be obtained prior to initiating the field studies.

i. A written annual report analyzing the data from the monitoring of the threatened valley elderberry longhorn beetle at the mitigation site on the South Fork American River shall be prepared annually for the life of the project by a qualified entomologist and submitted to the Service for approval. Three copies of the final report shall be conveyed to the Sacramento Field Office of the Service by August 31 of each year beginning the year the restoration plan is initiated. The report shall include, but not be limited to, the raw data collected during the field surveys and also a thorough analysis of the population dynamics of the valley elderberry longhorn beetle. The following shall be analyzed for the beetle: estimated population size (using both open and closed population models), and spatial distribution. Trends in food plant size and availability shall be analyzed. Maps showing where the individual adult beetles were observed shall be included. Real and likely future threats shall be addressed along with suggested mitigations (e.g. fencing access to off-road vehicles, etc.). At the end of each reporting period, the original field notes, photographs, correspondence, and all other pertinent material, as well as a copy of the report shall be deposited and accessioned into the Natural History Museum of Los Angeles County (Entomology Section, Natural History Museum of Los Angeles County, 900 Exposition Blvd., Los Angeles, California 90007) by September 30 of each year. All of the material shall be prepared to the standards of that institution. The Sacramento Field Office shall be provided with the accession numbers given to this material by the Natural History Museum of Los Angeles County. The Service may confer with the California Department of Fish and Game as part of the review of the progress of the mitigation plan.

The Service is to be notified within three working days of the finding of any injured or dead valley elderberry longhorn beetles or any unanticipated harm to elderberry host plants associated with project implementation. The Service contact persons for this information is Chris Nagano (916/978-4866 or FTS 460-4866). Any valley elderberry longhorn adult beetles found injured shall be turned in to the California Department of Fish and Game. The agency contact is Dr. Larry Eng (916/455-1383). Any valley elderberry longhorn adult beetles found dead shall be deposited in the Entomology Section of the Natural History Museum of Los Angeles County.

Conservation Recommendations

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. The term "conservation recommendations" has been defined as suggestions from the Service regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information. We recommend the following additional actions for the listed species.

1) The Corps undertake planting of elderberry shrubs in the 255 acre wildlife mitigation area along the east side of the Sacramento River. These efforts also possibly may benefit candidate species, including the giant garter snake (*Thamnophis gigas*) and the tricolored blackbird (*Agelaius tricolor*).

2) The Corps undertake planting of elderberry shrubs in the restoration areas in the Natomas East Main Drain and other suitable habitats of the American River Watershed Investigation.

This concludes formal consultation on work described in the biological assessment. Reinitiation of formal consultation is required if the amount or extent of incidental take is exceeded, if new information reveals effects of the actions that may affect listed species or critical habitat in a manner that was not considered in this opinion, and/or if a new species is listed or critical habitat is designated that may be affected by the action. We appreciate the time and effort your staff has provided in assisting us with this biological opinion. If you have any questions regarding this opinion, please contact Chris Nagano, staff entomologist, at (916) 978-4866 or FTS 460-4866.

Sincerely

Wayne S. White

Wayne S. White
Field Supervisor

cc: Regional Director (AFWE), FWS, Portland, OR
FWS-SFO (Federal Projects), Sacramento, CA (Attn: Gary Taylor)
Chief, Division of Endangered Species and Habitat Conservation, 4401 North Fairfax Drive, Arlington, VA 22203
Dr. Larry L. Eng, Department of Fish and Game, 1416 Ninth Street, Sacramento, CA 95814
Ms. Dee Warenycia, Department of Fish and Game, 1220 S Street, Sacramento CA 95814
Dr. Charles L. Hogue, Entomology Section, Natural History Museum of Los Angeles County, 900 Exposition Boulevard, Los Angeles, CA 90007

Literature Cited

Jones & Stokes Associates, Inc. 1987. Survey of habitat and populations of the valley elderberry longhorn beetle along the Sacramento River. Prepared for the U.S. Dept. of the Interior, Fish and Wildlife Service, Region One. 74 pp.

U.S. Fish and Wildlife Service. 1988. General compensation guidelines for the valley elderberry longhorn beetle. Unpubl. Endangered Species Office, Sacramento, CA 11 pp.

U.S. Fish and Wildlife Service. 1984. Recovery plan for the valley elderberry longhorn beetle. Endangered Species Program. Portland, OR.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Fish and Wildlife Enhancement
Sacramento Field Office
2800 Cottage Way, Room E-1803
Sacramento, California 95825-1846

TAKE PRIDE IN AMERICA

November 29, 1991

Colonel Laurence R. Sadoff
District Engineer
U.S. Army Corps of Engineers
Sacramento District
650 Capitol Mall
Sacramento, California 95814

Subject: American River Watershed Investigation

Dear Sir:

This letter transmits our enclosed detailed report and accompanying substantiating reports on the effects that proposed flood control alternatives for the American River watershed would have on the fish and wildlife resources. Our report has been prepared under the authority, and in accordance with the provisions, of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and is for inclusion in your feasibility report. We have made various recommendations regarding protecting fish and wildlife and mitigating for unavoidable fish and wildlife resource losses. Please advise the Fish and Wildlife Service of your proposed actions concerning these recommendations.

Because of the expedited schedule for completing this final Fish and Wildlife Coordination Act Report, we have not received concurrence in our report from the California Department of Fish and Game and the National Marine Fisheries Service.

We appreciate the cooperation and assistance of your staff during this comprehensive planning and reporting effort. For any questions regarding this report, please contact Wayne White at (916) 978-4613.

Sincerely,

Dale A. Pierce

for Wayne S. White
Field Supervisor

Enclosures

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Fish and Wildlife Enhancement
Sacramento Field Office
2800 Cottage Way, Room E-1803
Sacramento, California 95825-1846

In Reply Refer To:
1-1-92-TA-157

December 13, 1991

Colonel Larry Sadoff
Planning Division Attention: Mr. Walter Yep
U.S. Army Corps of Engineers
1325 J Street
Sacramento, California 95814-2922

Subject: American River Watershed Investigation-Mitigation Requirements and Recommendations Pursuant to the Endangered Species Act of 1973, as Amended, and Fish and Wildlife Coordination Act

Dear Mr. Yep:

This responds to your letter of December 5, 1991, requesting clarification of the measures needed to fully mitigate the impacts of the American River Watershed Investigation (project) pursuant to the Endangered Species Act of 1973, as amended (ESA), and the Fish and Wildlife Coordination Act (Coordination Act). At issue are the mitigation measures required for the threatened valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) (beetle) and other recommended measures for other fish and wildlife resources adversely affected by the project.

There are two issues of concern to the U.S. Fish and Wildlife Service. The first issue concerns the measures needed to offset impacts to the beetle that would occur upstream of the detention dam. Your staff was advised about the presence of suitable habitat and the likely presence of the beetle in our special report to your office, titled "CE-American River Watershed Investigation, draft report on the distribution and habitat for the valley elderberry longhorn beetle," dated April 2, 1991. Our biological opinion with its finding of no jeopardy to the beetle is based on the information you provided in your November 22, 1991, letter, addressing impacts to the beetle as subsequently confirmed in your December 5, 1991, letter, as well as other documents. It was our understanding that these documents incorporated the best scientific information available and included your assessment of the impacts along with your proposed mitigation plan as required to initiate consultation (50 CFR 402.14(c)).

The second issue concerns integration of mitigative measures for endangered species and other wildlife to accomplish both ESA and Coordination Act mitigation needs. As you are aware, we have examples of integrated mitigation planning in the Sacramento area in progress, i.e., Sacramento River Flood Control Systems Evaluation (Elkhorn site) wherein both endangered species and other wildlife mitigative measures were planned within the same compensation area. In the case of the Elkhorn site, through careful and detailed planning,

we were able to incorporate vegetative plantings in specific landscape designs so that wildlife habitat goals for both the beetle and other wildlife were met. This detailed integration planning was requested and supported by your agency and we agreed that it was a prudent and reasonable action.

In this project, there was no request for integrated planning to meet ESA and Coordination Act mitigation needs prior to issuance of our biological opinion or completion of the Coordination Act report. For this reason, two separate and independent analyses were completed pursuant to the ESA and Coordination Act requirements. Results of these analyses were included in our biological opinion, dated November 27, 1991, and our Coordination Act report, dated December 6, 1991.

We agree that integrating the mitigation measures needed under both Acts to the maximum extent possible is reasonable and prudent, however, without clear direction, funding and adequate time, we are unable to justify any change in our findings. It may be possible to credit portions of the planting of elderberry (*Sambucus* sp.) and other required vegetation on the lands that will be acquired on the South Fork American River as compensation for the beetle, as described in your letter of November 22, 1991, and our biological opinion, as partial mitigation for impacts for other fish and wildlife resources. However, we caution that such mitigation would need to include sound biological planning, and sufficient mitigation lands, including the correct ecological components, along the South Fork American River to offset the loss of all fish and wildlife values that would be lost above the proposed detention dam.

We remain willing to work with the Corps towards resolution of this issue. Please contact Chris Nagano (endangered species) at 916/978-4866 or Gary Taylor (other fish and wildlife) at 916/978-4613 if you have any questions.

Sincerely,

for Wayne S. White
Field Supervisor

cc: Regional Director (AFWE), FWS, Portland, OR

APPENDIX P
ENDANGERED SPECIES

Attachment 2

Survey For Federal- and State-Listed Rare Plants
in the Upper American River Watershed and Natomas Areas

Survey for Federal- and State-Listed Rare Plants in the Upper American River Watershed and Natomas Areas

Report submitted to Sacramento District, U. S. Army Corps of Engineers

By Charles Drost, Environmental Research

[north Natomas section by Roy Woodward]

February 15, 1991

ABSTRACT

Searches of several areas within the upper American River watershed were conducted for State- and Federal-listed rare plant species during the spring and summer of 1990. The areas identified were special substrate types (serpentine, limestone, diabase) within an area which would potentially be affected by the proposed Auburn dam. At each site, the physical characteristics and dominant vegetation were noted, and all identifiable plant species were recorded. Most of the areas could be thoroughly searched, and none of the rare plant species were found. In addition, the habitat at most of the sites did not correspond to that at sites where the target rare plant species have been recorded before.

Field surveys were also conducted for vernal pools in the north Natomas area north of Sacramento in spring and early summer. Several pools were discovered, but no threatened or endangered plant species were observed. Many of the sites previously identified on aerial photographs as potentially supporting vernal pools were found to have been severely disturbed.

The winter of 1989-90 was very atypical in the amount and interval of precipitation and followed three winters of below-normal rainfall. The negative results of the vernal pool portion of the survey must be considered as tentative in light of the detrimental effect that the low rainfall has had on wetland habitats such as vernal pools.

BACKGROUND

The proposed Auburn Dam under consideration by the Army Corps of Engineers would be located on the North Fork of the American River, approximately 2 km southeast of the town of Auburn. Different versions of the dam under consideration by the Corps range from a "dry" dam which would only retain water during periods of high runoff, to a multi-purpose dam which would create a permanent reservoir. The largest version of the dam under consideration would inundate upstream areas to a level of approximately 290 m (950 feet). This would affect portions of the Middle and North Forks of the American River and their tributaries along approximately 2.5 and 3 km of their length, respectively, above the dam site.

The Corps is also working on flood control plans for the north Natomas area, part of the floodplain of the Sacramento River approximately eight miles north of Sacramento. Areas potentially affected by this work encompass a roughly triangular area extending from the vicinity of the Pleasant Grove Creek Canal in the north, to the western portion of the city of Rio Linda in the southeast, to the Sacramento Metropolitan Airport and the northern end of the Yolo Bypass in the southwest.

In consultation with the Endangered Species offices of the United States Fish and Wildlife Service and the California Department of Fish and Game, the Sacramento District of the Corps of Engineers set forth guidelines for a survey for plant species of special concern in these project areas. The Corps' Scope of Works identified all plant species listed by the State of California or the Federal Government as threatened or endangered, which could potentially occur in the project areas (these plants are hereafter referred to as "target species"). Based on known habitat preferences of the target species, specific localities were identified where these plants were likely to occur within the project area (these specific localities are hereafter referred to as "delineated areas").

Delineated areas in the upper American River watershed are areas which were suspected to have peculiar soil conditions due to nutrient-poor parent rock outcropping at the surface (Table 1). Most of these areas were identified as serpentine, a metamorphic rock which has low levels of calcium, and very high (potentially toxic) levels of magnesium, iron, and silicates. Extreme serpentine habitats tend to have a characteristic flora which usually differs markedly from adjacent, non-serpentine habitats (Krukeberg 1984). Some of the other delineated areas were identified as having outcrops of other rock types (limestone, diabase) which also possess characteristic floras. Together, these delineated areas were considered potential habitat for several State and Federal rare or endangered plant species (Table 2a).

Delineated areas in the north Natomas vicinity were sites which were known or suspected to contain vernal wetlands. These vernal "pools" are unique topographic features which were once common in the Central Valley of California, but are now much reduced due to agricultural and urban development. Vernal pools are generally small, shallow depressions underlain with a clay hardpan, which only holds water for a short time after winter and spring rains. A variety of plant species have adapted to the seasonally wet conditions of the vernal pools. With loss of their habitat, some of these plants are now among the rarest species in California. Rare species identified by the Corps as possibly occurring at the north Natomas sites are listed in Table 2b.

Table 1. Areas delineated by Army Corps of Engineers, in cooperation with California Department of Fish and Game and U. S. Fish and Wildlife Service, as potential habitat for rare plant species in the upper American River area.

Area (map name)	Substrate	Quad	UTM
Shirttail Canyon	Andesite	Colfax	4323N 682E
Yankee Jim's[1]	Andesite	Colfax	4323N 681E
Sore Finger Point	Diabase	Colfax	4320.5N 679.5E
North Fork Lake	Basic	Greenwood	4318N 678E
North Fork Lake	Ultrabasic	Greenwood	4318N 677E
Murderers Bar[2]	Limestone	Auburn	4309N 672.5E
Mammoth Bar	Ultrabasic	Auburn	4310N 673E
Oregon Bar	Ultrabasic	Greenwood	4315N 679E
Kanaka Gulch[2]	Ultrabasic	Georgetown/ Foresthill	4319N 691E

1. 2 areas on North Fork below mouth of Shirttail Canyon and bridge on Yankee Jim's Road, on either side of the river

2. 2 areas, 1 on north and 1 on south side of Middle Fork

This report describes the results of field surveys for the target rare plant species within these areas during the spring and summer of 1990. Surveys of the upper American River sites were conducted by the author, while surveys of the Natomas sites were conducted under subcontract by Dr. Roy Woodward. In this report, a general description of the project area is given, along with an account of the methodology used in surveying the delineated areas. This is followed by descriptions of the delineated areas and the results of searches for the target rare plant species in these areas. The results include a description of the flora in each area and an accounting of any special concern species found. Descriptions and survey results are discussed first for the American River sites, then for the Natomas sites. The report ends with conclusions and recommendations based on the surveys.

I. Surveys in the upper American River area

PROJECT AREA

The North and Middle Forks of the American River in the Auburn Dam project area are deep, rugged canyons. Plant communities along the river in the elevational zone potentially affected by the dam are primarily mixed oak woodland (Foothill Woodland of Munz, 1968; Digger Pine - Oak Woodland of Holland, 1986) and chaparral, with lesser amounts of annual grassland. Community descriptions and plant and animal lists published for the Folsom Lake State Recreation area just downstream from the Auburn Dam project area (Newberry 1972) provide a good overview of the general setting in the project area.

SURVEY METHODOLOGY

Prior to conducting the field surveys, literature on the target species was reviewed. This included descriptions and illustrations in standard floras (Abrams 1923-60, Munz 1959) as well as type descriptions and subsequent articles dealing with the specific taxa.

Pressed specimens of all target species for the upper American River portion of the surveys were examined at the Jepson herbarium at the University of California at Berkeley. In addition, known localities of most of the target species were visited, and living individuals of the plants were examined in

the field (the type locality of Calystegia stebbinsii was visited, but the plant was not found; sites for two of the species listed as secondary targets of the survey - Chlorogalum grandiflorum and Helianthemum suffrutescens - were not visited). The target species were generally distinctive and easily recognized, particularly after seeing living individuals in the field. The most distinctive features of the living plants, as noted during these visits to known localities, are described for each species in Appendix 1.

The delineated sites were visited during the period March 3 through July 8. Except for the first trip in March, the visits were keyed to times when the target species were known to be flowering or otherwise recognizable, based on the visits to known localities. As described in the Results section, some of the sites did not appear to represent potential habitat for the target species; these sites were only searched once. The other sites were all visited and searched at least twice during the course of the surveys.

In general, the sites were searched by walking back and forth across the area in parallel lines, while scanning for any plants resembling the target species. Of necessity, this general pattern was varied to different degrees in each of the delineated sites due to steep slopes, impenetrable chaparral, or other features which prevented following a straight line. In two areas where access was limited across a steep slope, traverses were made up and down the slope from a single line across the length of the area.

Vegetation type and dominant species at each site were noted, along with general physical characteristics of the area and any distinctive features of the geology. All recognizable plants were noted, and careful inspection was made of any taxa in the same genera as the target species. All of these latter plants were identified to species, and are specifically noted in the results.

Table 2. State and Federal rare plant species identified by the Army Corps of Engineers as possibly present in Corps project areas: a) upper American River watershed; b) north Natomas area.

a) American River

Scientific Name	Common Name	Status
Calystegia stebbinsii	El Dorado Morning Glory	SE, FC2
Ceanothus roderickii	Pine Hill Ceanothus	SR, FC2
Chlorogalum grandiflorum	Red Hills Soaproot	FC2
Fremontodendron decumbens	Pine Hill Flannel Bush	SR, FC2
Galium californicum ssp. sierrae	El Dorado Bedstraw	SR, FC2
Helianthemum suffrutescens	Bisbee Peak Rush-rose	FC2
Phacelia stebbinsii	Stebbins' Phacelia	
Senecio layneae	Layne's Butterweed	SR, FC2
Wyethia reticulata	El Dorado County Mule Ear	FC2

b) north Natomas

Scientific Name	Common Name	Status
Cordylanthus hispidus	Hispid Bird's-beak	FC2
Cordylanthus palmatus	Ferris' Bird's-beak	SE, FE
Downingia humilis	Dwarf Downingia	FC3
Gratiola heterosepala	Bogg's Lake Hedge-hyssop	SE, FC2
Legenere limosa	Greene's Legenere	FC2
Orcuttia tenuis	Slender Orcutt Grass	SE, FC1
Orcuttia viscida	Sacramento Orcutt Grass	SE, FC1

RESULTS

Approximately 55 hours were spent in the field during a total of 13 visits to the different delineated areas during the period March 3 to July 8. An additional 19 hours were spent in the field in type localities of the various target species. Most of the visits to the delineated areas were during June, when both the early- and late-flowering species were in bloom. A specific accounting of the fieldwork is given in Appendix 2. Photos of each of the sites, along with photos of living examples of the target species in the field, are included under separate cover as Appendix 5.

Shirttail Canyon

Physical description: This is a very small area straddling the bottom of Shirttail Canyon on the east side of the North Fork. The south side of the canyon at this point is very steep - up to 40° - while the north side is somewhat terraced, with slopes of 15-20°. There is an extensive talus slope on the south side extending from the road down to the stream. There are scattered boulders on the north side. The outcropping rock in the bottom of the canyon is gray, fine-grained and crystalline, some of it with stripes of lighter material running through it (appears like limestone or marble).

Vegetation type / dominant plant species: Unbroken forest covers both slopes of this area. The forest gives way immediately adjacent to the stream to willow thickets along the stream. Dominant species in the forest are Umbellularia californica and Acer macrophyllum. There is a comparatively lush understory of ferns, mosses, and herbaceous plants under the trees.

Plant Species (approximate order of abundance):

Umbellularia californica
Acer macrophyllum
Alnus sp.
Toxicodendron diversilobum
Salix sp.
Lonicera sp.
Philadelphus lewisii
Mimulus guttatus
Clarkia spp.
Polypodium californicum
Dryopteris arguta
Adiantum jordani
Heuchera sp?
Sedum sp.
Eschscholzia californica
Equisetum sp.
Polypogon sp.
Epilobium sp.
Mimulus cardinalis
Heracleum sp.

Yankee Jim's (E)

Physical description: This area is along the North Fork, on the downstream side of the Shirttail Canyon site described above. It is about 1 km south of the bridge at Yankee Jim's road, on the east side of the river. This site was delineated as an area of andesite rock outcropping in the Corps' Fall 1989 Scope of Works. This stretch of the river is relatively steep (to 40^{o}), and faces west-northwest.

Vegetation type / dominant plant species: A tree cover of Heteromeles arbutifolia and Umbellularia californica covers about half of the slope, while the remainder consists of shrubby Heteromeles arbutifolia and Ceanothus spp. (30%) and grassy openings.

Plant Species (approximate order of abundance):

Heteromeles arbutifolia
Ceanothus integerrimus
Quercus wislizenii
Umbellularia californica
Aesculus californica
Toxicodendron diversilobum
Rhamnus sp.
Pityrogramma triangularis
Polypodium californicum
Dactylis glomerata
Bromus sp.
Clarkia sp.
Eriophyllum lanatum
Aster sp.
mosses
annual grass
Galium nuttallii
Geranium sp.
Adiantum jordani
Medicago sp.
Sedum sp.
Chlorogalum sp
Allium sp.
Brodiaea volubilis

Yankee Jim's (W):

Physical description: This area is on the west side of the North Fork, across from the area described above. A steep ravine below Yankee Jim's Road bounds the area on the north; the area extends approximately 200 m downriver from this point._Orientation of the slope along this stretch is east-southeast.

Vegetation type / dominant plant species: oak-pine woodland over most of slope, with willow and birch along the stream channel.

Plant Species (approximate order of abundance):

Pinus ponderosa
Quercus wislizenii
Umbellularia californica
Heteromeles arbutifolia
Toxicodendron diversilobum
Cercocarpus betuloides
Aesculus californica
Galium nuttallii
Hypericum sp.
Calochortus albus
Delphinium sp.

Along stream:

Salix sp.
Alnus sp.
Rubus sp.
Fraxinus sp.
Polypogon monspeliensis
Helenium sp.
Medicago sp.
Melilotus alba
Brassica sp.
Urtica sp.
Juncus sp.
Cyperus sp.

Sore Finger Point

Physical description: This site is on the east-facing canyon slope of the North Fork, north of Ponderosa Way. The rock type indicated for this area is diabase. The mapped location is at a small southeast-facing cove on the outside of a bend in the river 1.5 km north of Ponderosa Way. Based on surface rock outcrops and associated plant cover, however, the site may actually be about 0.5 km south, on an open, east-facing slope. This area has exposures of a dark, fine-grained surface rock which was not found in any of the visits to the mapped location. Also, the vegetation in this latter area is a mix of shrubs and herbaceous plants, contrasting with the rather uniform forest cover on the rest of the slope. Slope over most of the area is 15-20^{o}.

Vegetation type / dominant plant species: Dominant cover (ca. 60%) in the delineated area is a mix of shrubs and trees consisting of Quercus dumosa, Heteromeles arbutifolia, and Arctostaphylos viscida. A grass / herbaceous association covers the remainder of the area.

Plant Species (approximate order of abundance):

Quercus wislizenii
Umbellularia californica
Quercus dumosa
Arctostaphylos viscida
Heteromeles arbutifolia
Toxicodendron diversilobum
Ceanothus cuneatus
Styrax sp.
Rhamnus spp.
Aesculus californica
Eriogonum sp.
Galium nuttallii
Clarkia spp.
Calochortus albus
Brodiaea sp.
Dactylis glomerata
Phacelia sp.
Chlorogalum pomeridianum
unid grass
Galium sp. (annual)
Cirsium sp.
Gilia sp.

North Fork Lake (E)

Physical description: This site is on the west-facing side of the North Fork canyon, just south of the Ponderosa Way bridge. Topography of the area is mixed, ranging from flat (including a small meadow area) to moderate slopes, to some small cliffs. The lower slope along the river is very rocky. Predominant orientation of the area is northwest.

Vegetation type / dominant plant species: Most of the area (60%) is covered by a Pinus sabiniana / oak woodland. The remainder is weedy meadow (25%) and boulder piles along the river (10%).

Plant Species (approximate order of abundance):

Quercus chrysolepis
Quercus wislizenii
Pinus sabiniana
Umbellularia californica
Pseudotsuga menziesii
Pinus ponderosa - couple of individuals
Rubus sp.
Toxicodendron diversilobum
Aesculus californica
Cercis occidentalis
Cercocarpus betuloides
Brickellia sp?
Arbutus menziesii
Arctostaphylos viscida
Libocedrus decurrens
Vitis sp.
Avena fatua, Bromus diandrus, other annual grasses
Centaurea solstitialis
Eriophyllum lanatum
Daucus pusillus
Clarkia spp.
Pityrogramma triangularis
Adiantum sp.
Galium nuttallii
Polypodium californicum
Brodiaea sp.
Phacelia imbricata
Tragopogon dubius
Convolvulus sp.
Monardella sp.?
Trifolium sp.
Scutellaria sp.
Asclepias sp.
mosses
Rumex sp.

North Fork Lake (W)

Physical description: This is a steep (mostly 30o, to as much as 40-50o) slope on the east-facing side of the North Fork, about 1.3 km south of the Ponderosa Way bridge. Predominant orientation is east, with part of the area facing south.

Vegetation type / dominant plant species: Predominant cover throughout this section of the slope is oak / Umbellularia / Pseudotsuga (70%), with open grassy disturbed areas along the trail (ca. 30%).

Plant Species (approximate order of abundance):

Quercus sp.
Umbellularia californica
Pseudotsuga menziesii
Pinus ponderosa
Arctostaphylos viscida
Ceanothus sp.
Pinus sabiniana
Heteromeles arbutifolia
Aesculus californica
Toxicodendron diversilobum
Cercocarpus betuloides
Avena fatua
Centaurea solstitialis
Clarkia spp.
Eriogonum sp.
Sidalcea sp.
Lupinus sp.
Triteleia
Eriophyllum lanatum
Galium nuttallii
Hypericum sp.
Pityrogramma triangularis
Chlorogalum pomeridianum

Murderer's Bar (N)

Physical description: This is a steep (45^{o}) slope on the north side of the Middle Fork, about two km east of the confluence of the Middle Fork with the North Fork. The area is mapped as limestone and, judging from surface outcrops, the area is more extensive than shown on the map (e.g. there is a massive outcrop on the slope east of the delineated area which is also limestone).

Vegetation type / dominant plant species: Most of the slope is covered by dense chamise chaparral (90%) with very little understory. Scattered trees fringe the large outcrop toward the east end of the area. The remainder of the area is scattered open patches of weedy grassland (ca. 10%).

Plant Species (approximate order of abundance):

Adenostoma fasciculatum
Quercus dumosa
Heteromeles arbutifolia
Arctostaphylos viscida
Eriodictyon californicum
Cercocarpus betuloides
Galium nuttallii
Phacelia imbricata
Castilleja sp.
Centaurea solstitialis
unidentified annual grass

Murderer's Bar (S)

Physical description: This area is on the south side of the river across from the area just described, and is reached from California Highway 49. The slope is moderately steep (up to 30^o) and is marked by an area of towering limestone cliffs about halfway down to the river. Orientation of the slope is north-northeast. The area of the slope along the river itself (up to about 30 m above the level of the river) is open, barren limestone gravel and rubble due to extensive, ongoing surface mining of the area. This area is also more extensive than shown on the map - it extends approximately 1 km upriver from the mapped area on the south side, as evidenced by the gravel mining operations, which are continuous up the river to that point.

Vegetation type / dominant plant species: The slope is covered by a mostly continuous forest cover (90%) dominated by Quercus spp., Umbellularia californica, and Heteromeles arbutifolia, along with Pinus ponderosa and Pseudotsuga menziesii on the higher reaches of the slope.

Plant Species (approximate order of abundance):

Quercus kelloggii
Quercus wislizenii
Umbellularia californica
Quercus chrysolepis
Heteromeles arbutifolia
Acer macrophyllum
Pinus sabiniana
Pseudotsuga menziesii
Aesculus californica
mosses
Dryopteris arguta
Adiantum jordani
Geranium sp.
Galium nuttallii
unid annual grass
Hypericum sp.
Eriophyllum lanatum
Clarkia spp.
Centaurea solstitialis
Balsamorhiza deltoidea

Mammoth Bar

Physical description: This site is a ridge on the north side of the Middle Fork, upstream from the Murderer's Bar site. The ridge faces south-southeast and is bounded by a small, wooded ravine on the west and a larger canyon on the east (Murderer's Gulch). Slope is mostly 10-15°, steeper in some parts.

Vegetation type / dominant plant species: Dominant vegetative cover on the ridge is oak / digger pine chaparral (60-70%), with the remainder of the area consisting of weedy, disturbed openings (30%). The chaparral is relatively open with an extensive understory of grasses and other herbaceous plants, mosses, and some ferns. Trails, gullies, and bare ground criss-cross parts of the slope from extensive dirt-bike use of the area.

Plant Species (approximate order of abundance):

Quercus wislizenii
Q. douglasii
Q. dumosa
Heteromeles arbutifolia
Arctostaphylos viscida
Pinus sabiniana
Toxicodendron diversilobum
Ceanothus cuneatus
Aesculus californica
Vitis sp.
Lupinus albifrons
annual grass, incl. Avena, Bromus and Festuca sp.
mosses
Erodium sp.
Centaurea solstitialis
Eriophyllum lanatum var. grandiflorum
Hypericum sp.
Triteleia sp.
Clarkia sp.
Castilleja sp.
Galium nuttallii
Scrophularia californica
Chlorogalum pomeridianum
Hypochoeris sp.
Mimulus sp.
Lotus sp.
Eriogonum sp.
Sidalcea sp.
Gilia sp.

Following species on the shoal along the river:

Rubus sp.
Polypogon monspeliensis
Helenium sp.
Medicago sp.
Melilotus alba
Urtica sp.
Juncus sp.
Cyperus sp.

Oregon Bar

Physical description: This is a small area along a tributary stream on the north side of a large, sharp bend in the Middle Fork (Cherokee Bar / Greenwood Bridge area). The delineated area is on the east side of the tributary stream, and extends down to about 200 m from the Middle Fork on the downhill side. Orientation is predominantly southwest, and slope is mostly 15-20^{o}, though there are a few very steep areas (up to 50^{o}). Rock type indicated for the area is serpentine.

Vegetation type / dominant plant species: The upper part of the area is a woodland consisting mostly (90%) of Quercus spp. and Heteromeles arbutifolia; the lower part is open, scattered Pinus sabiniana (25%) in shrubland consisting of Heteromeles arbutifolia, Ceanothus cuneatus, and a few Arctostaphylos viscida (60%), with the remaining open areas covered with weedy annual grassland.

Plant Species (approximate order of abundance):

Pinus ponderosa
Quercus kelloggii
Q. wislizenii
Heteromeles arbutifolia
Quercus chrysolepis
Umbellularia californica
Pinus sabiniana
Acer macrophyllum
Arctostaphylos viscida
Quercus dumosa
Arbutus menziesii
Toxicodendron diversilobum
Ceanothus cuneatus
Avena fatua, other annual grasses
Centaurea solstitialis
Eriophyllum lanatum
Clarkia sp.
Polypodium californicum
Adiantum jordani
Grindelia sp.
Chlorogalum pomeridianum
Lupinus spp.
Galium nuttallii
Convolvulus sp.
Tragopogon sp.
Wyethia angustifolia

Kanaka Gulch (N)

Physical description: This site is along the Middle Fork where Volcano Creek empties in from the north (southeast of the town of Foresthill). The canyon along this stretch is high (ca. 600 m from the rim to the level of the river) and steep. The slope is 30-40^{o} over most of the area, but range up to 45^{o}. Prominent ridges on either side of Volcano Creek bound the delineated area. Orientation is predominantly south, with some southeast-facing, and some west-facing slopes. There has been some mining / road-building in the east part of the area along the river, with a wide strip of boulders and broken rock on the lower slope, extending 20-30 m upslope. This area extends farther west than shown on the map, based on surface exposures of rock. The serpentine rock is very conspicuous throughout most of the area - large amounts are broken up and exposed on the steep lower slope above the river.

Vegetation type / dominant plant species: Higher on the slope, the predominant cover is a chaparral consisting of Quercus durata, Ceanothus cuneatus, and Heteromeles arbutifolia. Steep stretches along the river consist of mostly barren rock / talus or a thin chaparral with Pinus sabiniana. Open areas are vegetated with a weedy annual grass association. Betula and Salix thickets occupy the flats along the river.

Plant Species (approximate order of abundance):

Adenostoma fasciculatum
Ceanothus cuneatus
Heteromeles arbutifolia
Quercus durata
Pinus sabiniana
Umbellularia californica
Betula sp.
Salix sp.
Rubus sp.
Rhamnus crocea
Arctostaphylos viscida
Avena sp.
Brodiaea sp.
Eriogonum sp.
Pityrogramma triangularis
Geranium sp.
Eriodictyon californicum
Conyza sp.
Festuca sp?
Phacelia imbricata
Galium nuttallii
Chlorogalum pomeridianum

Kanaka Gulch (S)

Physical description: This area is on the south side of the river, across from the area above. Serpentine exposures are much more limited on this side, with most of the slope having a heavy forest cover. Orientation is northerly, varying from north-northwest to east-northeast. The slope is moderately steep, reaching 40-45° in the higher reaches, but flattens out into an extensive bar along the river.

Vegetation type / dominant plant species: Most of the slope is covered by Pseudotsuga forest, with Quercus chrysolepis, Umbellularia californica, and Acer macrophyllum in the lower reaches near the river. The understory is mossy with abundant ferns. The one narrow ridge which was identifiably serpentine was more sparsely vegetated with Pinus ponderosa, P. sabiniana, and Arctostaphylos viscida. Thickets of Betula and Salix fringed the river.

Plant Species (serpentine area):

Arctostaphylos viscida
Pinus ponderosa
P. sabiniana
Eriophyllum lanatum

DISCUSSION

None of the target rare plant species were found in the surveys of the upper American River watershed. Related species were found, but there was no difficulty in distinquishing any of these from the target species. In general, these related species are different enough that they can be identified at a glance, but a point was made of inspecting at least a selection of individuals at each site during each survey. Distinquishing features of species related to the target rare plants are discussed in Appendix 3.

Intensity of coverage of the different delineated areas varied depending on the physical features of the area and, in the case of chaparral, with the density of the vegetation. On the west side of the North Fork Lake site, the steep slope precluded a systematic coverage of the entire slope. On the north side of the Murderer's Bar site, a dense cover of chaparral on a steep slope prevented thorough coverage of the entire mapped area (in the case of the Murderer's Bar site, the heavy cover also prevented an on-the-ground determination of the exact extent of the rock formation mapped for the site). In both of these cases, the outer edges of the mapped area were searched (upper, lower, and sides) and forays across the rest of the site were made as possible, given the slope and vegetation.

None of the sites evidenced the sort of extreme edaphic influence on the vegetation that frequently characterizes serpentine and other physiologically stressful habitats. In most of the sites, there was no readily apparent difference in the stature or species composition of the vegetation on the mapped area when compared with adjacent areas. The north side of the Kanaka Gulch site was the only obvious exception to this generalization. At this site, the plant cover is chamise chaparral with scattered Pinus sabiniana, a characteristic association on serpentine (e.g. Hanes 1977, Krukeberg 1984). Also, the serpentine endemic Quercus durata is a common component of the chaparral here (Q. durata was not noted in any of the other areas). Even at Kanaka Gulch, though, the chaparral was relatively tall and dense, not thin and dwarfed as occurs under extreme serpentine conditions.

Because there was no evident serpentine influence, some of the sites were not visited a second time. The other areas were checked two or three times. In addition to not finding the target plant species, however, the impression obtained from the appearance of the habitat (as compared to the habitat at known localities for the target species) suggested that these were not appropriate sites for the target species.

Some other areas were visited, based on exposures of serpentine-like rock or limestone along road cuts: the vicinity of the Foresthill bridge over the North Fork and the area downstream from the California Highway 49 bridge (just south of the confluence of the North and Middle Forks). These areas were not covered completely, but the target plants were not found in the searches which were conducted, and there was no evidence of edaphic influence on the overall vegetation in these areas.

Based on both the negative results of the field searches and the overall appearance of the habitat, it does not appear that any of the target rare plant species are present within the delineated areas of the upper American River watershed. The certainty with which this assertion can be made varies with the different rare plant species which were search targets. The two prostrate shrubs on the list - Fremontodendron decumbens and Ceanothus rodericki - almost certainly are not present because the open chaparral habitat which would allow their growth is not present in any of the areas.

Of the other species, Wyethia reticulata and Chlorogalum grandiflorum are large, showy species which should not have been missed in the thorough searches of the delineated areas. Galium californicum var. sierrae, though small, is conspicuous because of its gray-green pubescent stems and leaves, and I do not believe this species could reasonably have been overlooked. Helianthemum suffrutescens should also have been relatively conspicuous for its gray-green foliage and virgate habit. Calystegia stebbinsii was not seen in the field, but the strikingly dissected leaves should have made this species stand out. Senecio layneae is rather small, but the leafy base, coarsely serrate leaves, and few (four or five), bright yellow rays per head set it apart from all of the yellow composites seen at the survey sites. [I add one cautionary note on this last species, however: Senecio layneae was not easily found at the literature locality I checked. Only one small group of plants was found in an hour-long search over a serpentine hillside. This is the only indication I saw among the target rare plants of a very sparse, scattered distribution in localities where the plant was known to be present.]

II. Surveys in the Natomas area

PROJECT AREA

The north Natomas area is a large, low-lying plain along the lower Sacramento River north of the city of Sacramento. The area formerly supported extensive native wetland habitats, but is now given over in large part to agriculture. Though there is concern about the loss of riparian areas, freshwater marsh, and other wetlands in the state, vernal pools were the object of particular concern for these surveys because of several rare plant species which are only found in vernal wetland habitats. North Natomas and surrounding areas are known to possess some important remnants of this habitat. Though there have been comparatively recent surveys of vernal wetlands in this part of the Central Valley (e.g Macdonald 1976), these habitats and their associated flora remain relatively poorly known.

SURVEY METHODOLOGY

Maps of the survey area showing potential wetland habitats and a list of endangered and threatened plant species which could potentially be present in these areas were provided by the Corps of Engineers, in consultation with the Endangered Species offices of the California Department of Fish and Game and the U. S. Fish and Wildlife Service.

The target species are relatively conspicuous if they are present in a vernal pool. Dr. Woodward is familiar with identification characters of these species from earlier surveys conducted in other areas. In addition, illustrations and/or herbarium specimens of each species were examined prior to the start of the survey.

The delineated areas were all easily accessible by car and on foot, and each potential site was visited and examined to determine if vernal pools were present. The areas were visited four times during the spring and early summer: March 9, April 19, May 30, and June 14. When vernal pools were found, they were closely inspected to identify what plant species were present. Some vernal pools were discovered at sites not indicated on the maps, and these pools were mapped and surveyed in the same manner as the pools in the delineated areas.

Since size and depth of vernal wetlands varies both from year to year and over the course of an individual season, such measures were only recorded in a general way. Subjective estimates of depth of the deepest part of the pool were recorded as shallow (< 3"), moderate

(3 - 6"), and deep (> 6"). These estimates of depth were made relative to the general elevation of the surrounding land surface, exclusive of hummocks.

During the initial visits, several of the sites were discovered to have been plowed for farming or otherwise disturbed to the extent that there was no chance that vernal pools were present. These sites were not revisited on subsequent survey dates.

RESULTS

The 1989-90 rainfall year (July to June) was poor for vernal wetlands. Total precipitation for the year (19.4 inches; data for the NOAA Sacramento Weather Service Office) was somewhat above average, but the distribution of the rain was unfavorable for vernal pool plants. Early rains during September through November were too early promote germination and growth, while December was completely dry. December is an important month because this is the period when many vernal pool plants begin to germinate. Much of the rainfall for January through March, though sufficient in amount, came in a few large storms which left the pools dry for long periods between storms.

The location of vernal pools discovered during these surveys are shown in Figures 1a and 1b (see also Appendix 4). Areas searched are represented as stippled areas on the maps, and pools are indicated by arrows. Vernal pools were recognized (whether they were holding water or had dried up) by having a characteristic flora associated with such areas. This included Deschampsia danthonioides, Psilocarphus brevissimus, Eleocharis acicularis, Eryngium vaseyi, Plagiobothrys sp., Plantago sp., and Ranunculus bonariensis var. trisepalus.

A number of other species were found in the vernal wetlands, including Hypochoeris glabra, Bromus mollis, Avena barbata, Festuca megalura, Erodium sp., Hordeum leporinum, Lasthenia glabrata, Rumex sp., and Lolium multiflorum. These plants are typically grassland species, and most of them are non-native. They are not typical of vernal pools.

Figure 1a. Areas surveyed for vernal pools and target rare plant species associated with vernal pools (north half - Pleasant Grove area). Areas which were surveyed are stippled; vernal pools are indicated by arrows.

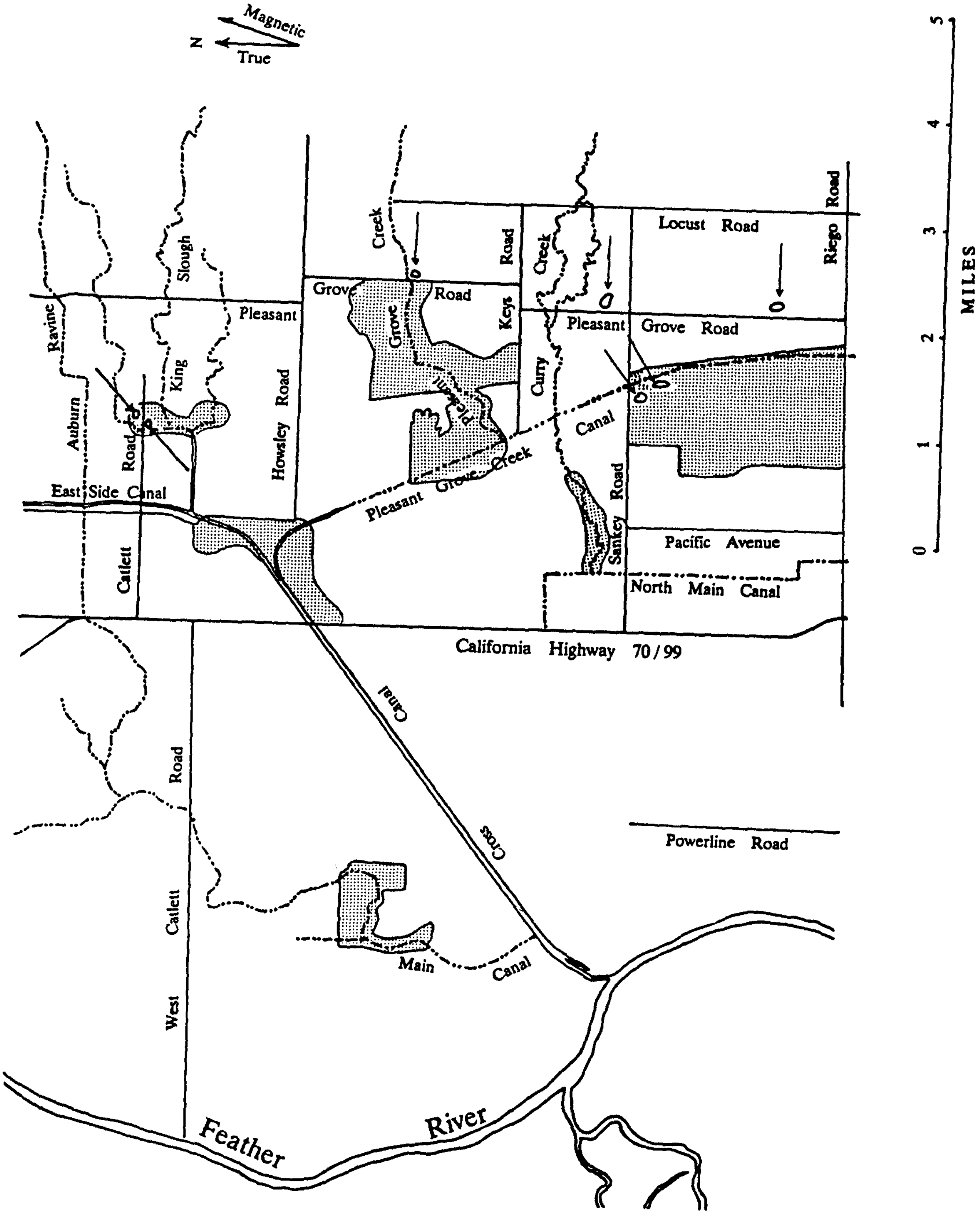
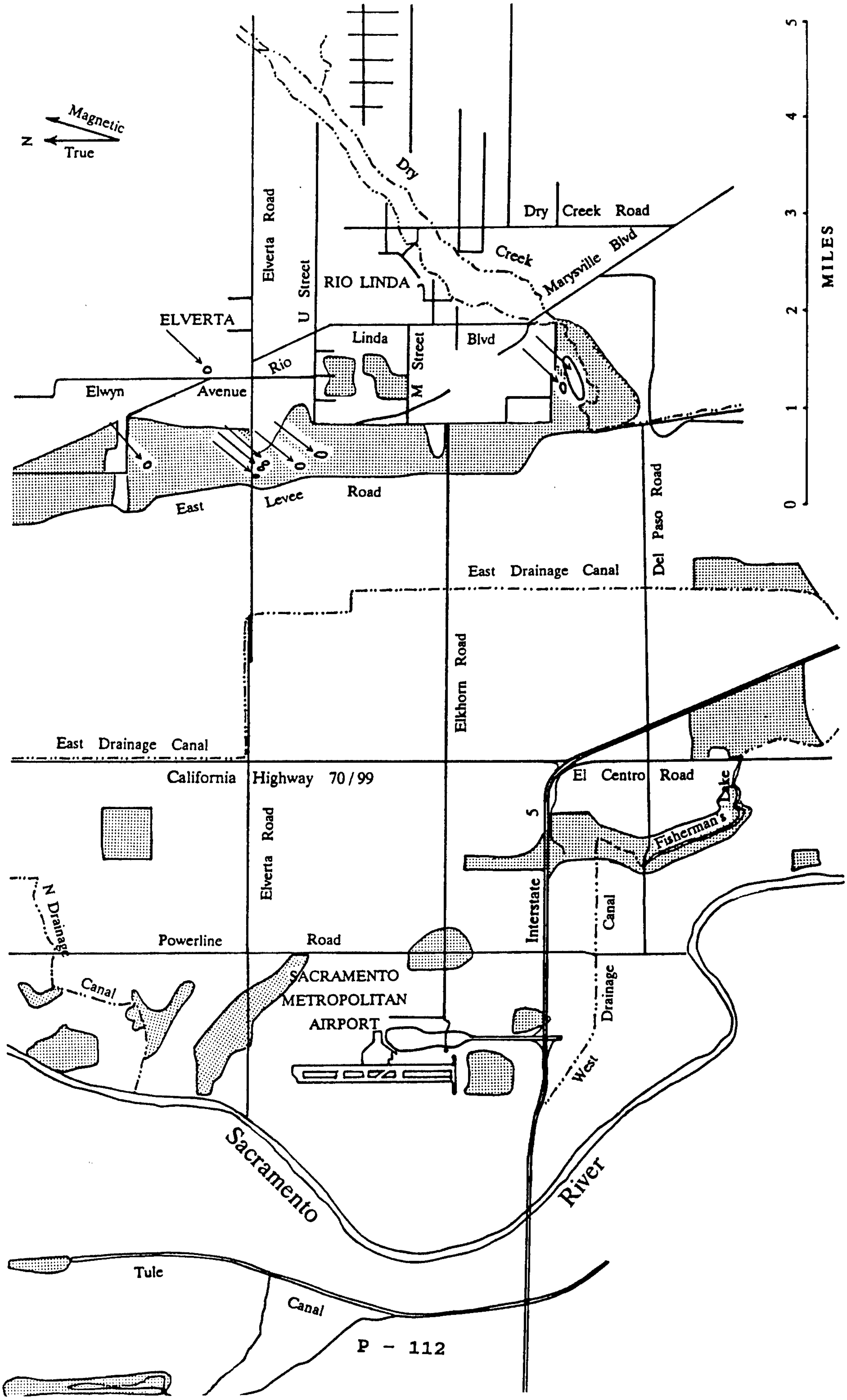

Magnetic
N
True
Ravine
Auburn
Road
King
Slough
Pleasant
Howsley Road
East Side Canal
Catlett
Grove
Road
Creek
Grove
Pleasant
Keys
Road
Curry
Creek
Pleasant Grove Creek
Canal
Pleasant
Grove Road
Locust Road
Riego Road
Sankey Road
Pacific Avenue
North Main Canal
California Highway 70/99
Canal
Cross
Road
Catlett
West
Powerline Road
Main Canal
Feather River
0
1
2
3
4
5
MILES

Figure 1b. Areas surveyed for vernal pools and target rare plant species associated with vernal pools (south half - Rio Linda area). Areas which were surveyed are stippled; vernal pools are indicated by arrows.



Magnetic
N
True
MILES
0
1
2
3
4
5
Dry
Creek
Dry Creek Road
Marysville Blvd
RIO LINDA
ELVERTA
Elverta Road
U Street
Rio Linda Blvd
M Street
Elwyn Avenue
East Levee Road
Del Paso Road
East Drainage Canal
Elkhorn Road
East Drainage Canal
California Highway 70/99
El Centro Road
Fisherman's Lake
Interstate 5
Elverta Road
N Drainage Canal
Powerline Road
West Drainage Canal
SACRAMENTO METROPOLITAN AIRPORT
Sacramento River
Tule Canal

The mixed species composition seen in the vernal wetlands surveyed was due to the continuing drought (this same condition was observed in other vernal wetlands surveyed in other parts of the state during 1990). In general, at least two weeks of submersion is required to kill most grassland species after they germinate and prevent their appearance in the vernal pool flora. Even in good precipitation years it is not unusual to find occasional grassland species in vernal pools, but in 1990 these species were dominant, especially in the May survey.

Invasion of a vernal pool by weedy grassland species does not mean that the vernal pool ceases to exist. The topography and soils of the site will allow the area to once again flood when adequate rainfall occurs. Seeds and bulbs of vernal pool species can lay dormant in the soil for many years until the appropriate environmental conditions return for germination and growth.

The following notes refer to the lettered areas on the maps in Appendix 4. All of the areas identified by the Corps as potential vernal pool sites are outlined with a broad black line on the appendix maps and have a map / letter designation. Existing vernal pools identified during this survey are outlined in yellow. Additional vernal pools outside the areas delineated by the Corps are also outlined in yellow and are discussed below. In the following accounts, soil type in the vicinity of identified vernal pools is taken from the maps of the Sacramento and Sutter County soil surveys (U. S. D. A., Soil Conservation Service). All other notes were recorded in the field.

Map 1:

- 1A - no pools; area flooded and plowed
- 1B - no pools; area flooded and plowed
- 1C - several shallow vernal pools at the north end of the area; soil type in this vicinity is Snelling Loam
- 1D - no pools; area flooded
- 1E - no pools; riparian area
- 1F - There is one vernal pool in the north part of this area; this pool is at the low end of the field and is of moderate depth. Soil in the vicinity is San Joaquin Sandy Loam.

Map 2:

2A - There are some pools at both the north end and the south end of the area; most are small and moderately grazed by livestock; these pools vary from shallow to moderate in depth. Many are connected by small, shallow drainages. Soil type in the vicinity of the pools is mostly San Joaquin Fine Sandy Loam.

2B - no pools; annual grassland

2C - no pools; annual grassland

2D - no pools; flooded, irrigated, or too steep

* An additional pool was located just north of Elverta (see map). This pool is fairly large and of moderate depth. Soil is Hedge Loam / San Joaquin Fine Sandy Loam.

Map 3:

3A - There is one small, shallow pool at the north end of the area. Soil in this vicinity is Galt Clay.

3B - no pools; flooded or plowed

* Three additional pools of moderate depth were located just east of 3A and 3B along Pleasant Grove Road. One of these pools, just south of Pleasant Grove Creek along the east side of Pleasant Grove Road, contained Boggs Lake dodder (Cuscuta howelliana). This species is on the California Native Plant Society's List 4 (limited distribution; Smith and Berg 1988) but has no official protected status. Soil in the vicinity of all three pools is San Joaquin Fine Sandy Loam.

Map 4:

4A - no pools; some tules (Scirpus acutus) in ditch

4B - no pools; tules and lone valley oak (Quercus lobata)

4C - no pools; tules, irrigated pasture

4D - no pools; tules, valley oak, elderberry (Sambucus sp.), pasture

4E - no pools; flood-irrigated

4F - no pools; irrigated; tules, annual grass on southeast side

4G - no pools; leveled and plowed

4H - no pools; plowed

4I - no pools; riparian along substantial slough, otherwise plowed

4J - no pools; plowed

4K - no pools; plowed, tules in irrigation ditch

4L - no pools; riparian area along slough

Map 5:

5A - no pools; riparian forest and/or flooded

5B - no pools; mostly flooded, some riparian

DISCUSSION

None of the target rare plant species were found in the survey area. Based on a subjective scale relative to other vernal pools the author has seen throughout California, most of the pools seen in the survey area were rated as "good." It is possible that one or more of the pools may contain some of the State- and Federal-listed rare plant species targeted for this survey, but the species did not grow this year because of the preceding poor rainfall season. Poor growing conditions in the spring and summer of 1990 were compounded by poor rainfall in the preceding three winters, as well.

CONCLUSIONS AND RECOMMENDATIONS

The delineated sites in the upper American River watershed were searched thoroughly during the winter, spring, and early summer of 1989-90, and none of the target rare plant species were found. In addition, based on surface exposures of rock and the character of the plant cover, only a few of the sites (notably Kanaka Gulch) showed evidence of the strong edaphic influence that characterizes the known localities for the target rare plants. Searches of two additional areas with serpentine exposures, outside of the areas delineated by the Corps, also failed to turn up any evidence of the target rare plants. Based on visits to known localities, this did not appear to be a notably poor year for the target rare plant species (with the possible exception of Senecio layneae), in spite of the low winter rainfall. Unless additional potential habitats or additional rare plant species are identified as being within the project area, further surveys should not be necessary.

In the north Natomas area, the surveys located significant vernal wetland habitats. Identification of such habitats is not dependent on the amount of rainfall in a particular year, as elements of their characteristic flora persist even in poor years. For this reason, the surveys were adequate for locating and mapping the distribution of the habitat itself. However, failure to find the rare species targeted by these surveys may be due to the poor rainfall conditions of the past four years. The pools identified on the accompanying maps should be resurveyed following a winter with more normal rainfall before conclusively deciding that the target rare plant species are not present.

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Appendix 1. Descriptions of rare plant species specifically searched for in the upper American River: notes recorded for each species during visits to known localities.

Ceanothus rodericki - 1 individual at summit in front of gate into lookout tower compound; sprawling on ground and over small boulders, covering ca. 12 sq m; in open with few scattered Arctostaphylos viscida and Cercis; stems grayish-white; lvs sm (6-8mm long x 4-5mm wide), thick, obovate, truncate or notched at tip (shape similar to those of C. cuneatus); some of lvs partly rolled upward and inward from midvein; some of lvs on ascending branches are also angled upward so that underside of lf is visible from above or side; underside of lvs dull white, 1 main vein with conspicuous, parallel branch veins; plant past flowering; fruit rel. large compared to small size of lvs (fr peduncle 7mm long, fr 5mm across, rounded, with no crests or horns) [4 or 5 other individuals seen, on westerly slope below lookout tower compound, and in rocks along road; all plants in open, with Adenostoma and Arctostaphylos] (CA, Eldorado Co.: Pine Hill)

Fremontodendron decumbens - along downhill side of dirt road, group of 4 or 5 plants in opening in oak woodland; low, spreading shrub, densely branched, one forming an extensive mound ca. 0.5 m high and 5 m across; lvs sandpapery in appearance and texture, from stellate pubescence; all of the plants in this group are blooming, w/ numerous orange-yellow flowers, ca. 3-4 cm across (CA, Eldorado Co.: Pine Hill)

Galium californicum ssp sierrae - common, hillslope just above road in shade of black oak (also in partial sun in cleared area below road; these latter plants larger, more robust); growing in small upright tufts of 3-4 stems, 8-15 cm tall, with little or no evident woody stem; gray-green throughout, stems and lvs densely pubescent with spreading whitish hairs; lvs elliptic, 3-4mm wide, 10-12mm long; corolla pale yellow, 3-4 mm across; fruit finely pubescent (CA, Eldorado Co.: Pine Hill)

Phacelia stebbinsii - common to abundant in local areas along stream on N- to NW-facing slope, in nearly full sun to moderate shade under Douglas Fir; somewhat scattered - some individuals in moist areas adjacent to stream, others in patches a few feet up from the stream, where they are the numerically dominant species; substrate is dark, fine-textured rock; in association with mosses, Claytonia sp, yellow-fl Sedum sp.; 1 dm tall, with pubescent stems, reddish in places; lvs pubescent, elliptic to lance-elliptic, to 30mm long with petiole to 15mm long; lvs mostly entire, but some with a pair of earlike lobes at base; majority of plants have flower buds at this time, a few individuals are blooming; fl white, petals 4-5mm long, sepals 3-3.5mm, stamens long-exserted, ca. 7mm long (CA, Eldorado Co.: Leonardi Springs area)

Senecio layneae - in opening in Quercus durata / Rhamnus / C. cuneatus; 15 plants in space of 2m x 1/2m, along low gravelly rill; mostly bare ground - few Chlorogalum, Eriophyllum, Triteleia. Plants agree with most aspects of Abrams' description - heads with 4 or 5 rays, central flowering head overtopped by outer, etc. However, they differ from the written description in that the leaves are almost all coarsely serrate, with long teeth up to 2mm long. Some of the lvs have lobes along the lower 1/4 of the leaf. Also, the disk of the flowering heads is a little less than 1 cm broad (Both of these latter characters agree with specimens examined at the Jepson herbarium, however). -- (Eldorado Co. near jct of Bear Creek Rd and Meadowbrook Rd off CA 193)

Wyethia reticulata (site 1) - 20m downslope from road, group of 5 individuals growing in area 70m long by 30m wide; plants small (2.5-3.5dm high), no flower buds yet; lvs long-triangular, truncate to subcordate, 13-14cm long, 6-7cm wide, scabrous above, sticky below; lvs w/ veins rather deeply impressed, matching pattern in Abrams illustration (3 veins from base, w/ closed cells along outside margin of the 2 lateral veins); no basal lvs, and cauline lvs essentially the same size all the way up the stem; surrounding area bare mud, w/ scattered isolated plants, incl Helianthella, Wyethia angustifolia, and Galium spp

Wyethia reticulata (site 2) - fairly numerous in open areas on summit; some plants with lg heads not yet open; bracts on heads (esp. outer) rather large and foliaceous (lanceolate or ovate-attenuate) -- this seems to differ from the written descriptions (CA, Eldorado Co.: Pine Hill)

Appendix 2. Dates of field surveys for rare plants at sites along the upper American River.

Area (map name)	First Survey	Subsequent Surveys
Shirttail Canyon	June 19	
Yankee Jim's	June 19	
Sore Finger Point	June 21	
North Fork Lake	March 3	June 12 June 21
Murderers Bar	March 3	June 10 July 7
Mammoth Bar	June 10	
Oregon Bar	June 21	
Kanaka Gulch	June 14	July 8

Appendix 3. Notes on some plant species found in upper American River watershed survey sites which are congeneric with target rare plant species searched for at the sites.

1) Scattered individuals of the Phacelia imbricata complex were seen at most of the sites. This species is somewhat similar to P. stebbinsii in leaf shape, but is otherwise very different. It is a large perennial (P. stebbinsii is an annual) over 0.5 m in height, with a basal rosette of leaves mostly 2- or more pinnate; flower parts are much larger than in P. stebbinsii also (e.g. calyx lobes 4mm long x 1mm wide, enlarging to 8-9mm long x 2-3mm wide in fruit - measurements of specimen collected at N side of Kanaka Gulch).

2) A small group of Balsamorhiza deltoidea was present on the upper slope on the south side of the Murderer's Bar area. Wyethia angustifolia was noted in the surrounding area, but was not seen in any of the delineated areas. Both of these species have large leaves that are primarily basal, as compared with W. reticulata, which has large leaves along the entire stem, and no basal cluster of leaves. Also the leaves of W. angustifolia are lanceolate, much narrower than those of W. reticulata. B. deltoidea, like other members of that genus, is lacking any sort of pappus.

3) Galium nuttallii was common in all of the sites searched. It was easily identified by its clambering habit, long, thin woody stems, retrorse scabrous stems and leaves, and large, glabrous fruits. The long woody stems, high-clambering habit, comparatively sparse, scabrous pubescence are all very different from G. californicum sierrae (cf. Appendix 1). An annual Galium was present on the west side of the North Fork Lake site. This plant, though not identified to species (it did not have fruit) was readily distinguishable from G. californicum sierrae by the lack of any woody stem tissue, and the much larger, more widely spaced leaves, which were six at each node (4 in G. californicum sierrae)

4) Chlorogalum pomeridianum was scattered, but conspicuous at most of the sites. It was distinguished as this species and not C. grandiflorum not only by the shorter (included) stamens, but also by its much larger stature (> 1 m) and its longer flowering pedicels.

5) Ceanothus cuneatus is perhaps the closest relative of C. rodericki, and was present at several sites. In addition to its upright habit (compared to the prostrate C. rodericki), it is larger overall than the latter species, and has conspicuously horned fruit. C. integerrimus was also present at some sites, but differs from C. rodericki in leaf shape and venation as well as growth form and fruit characteristics.

Appendix 4 (large format maps) - Vernal pools in the north Natomas area. Areas identified as having potential for vernal pool development are outlined with a wide black line. Actual vernal pools identified during the survey (both within and outside the areas delineated by the Corps) are outlined in yellow. The map numbers and letters at individual sites are keyed to notes on that area in the main text (e.g. 1A refers to map 1, delineated area A, etc.).

Appendix 5. Photos of rare plant survey sites on the upper American River, and "target" rare plant species specifically searched for during the surveys. The target rare plants were photographed at the type locality or at other sites recorded in the literature.

1) Middle Fork of American River, Kanaka Gulch: serpentine exposure on W-facing slope of Blind Canyon (N side of river, elev. ca. 2200 ft.); Ceanothus cuneatus - leather oak - digger pine association
2) Middle Fork of American River, Kanaka Gulch: scrubby, digger pine - covered knoll on S side of river (looking from N side)
3) Middle Fork of American River, Kanaka Gulch: mixed ponderosa pine - digger pine - chaparral association on N side of river
4) Middle Fork of American River, Kanaka Gulch: steep, relatively barren, serpentine slope along N bank of river (looking W from S side of river)
5) Middle Fork of American River, Kanaka Gulch: looking upstream (E) from W end of survey area; serpentine slope along N side of river
6) Middle Fork of American River, Kanaka Gulch: digger pine on serpentine knoll on S side of river
7) Middle Fork of American River, Kanaka Gulch: serpentine outcrop along roadcut, lower slope along N side of river (looking E)

8) W-facing lower slope of the North Fork of the American River, just N of the Auburn-Foresthill bridge; photograph taken from the W end of the bridge, looking approximately east-northeast
9) W-facing slope of North Fork of the American River south of the Auburn-Foresthill bridge, from the W side of the bridge; slope mostly open, with scattered dark shrubs and pine trees; river visible in bottom of photograph
10) American River S of the U.S. 49 bridge, looking from the Auburn-Foresthill bridge; old concrete bridge visible in center of photo, U.S. 49 visible just to right of bridge, winding up the hill; W-facing slope covered with Digger Pine with chaparral understory

11) E side of North Fork at Yankee Jim's - looking downriver from along the road just west of the river
12) W side of North Fork at Yankee Jim's - looking downriver from along the road just west of the river
13) N end of the survey site at Yankee Jim's (W side)

14) S end of the survey site at Yankee Jim's (W side), looking S (downriver)

15) Shirttail Canyon survey site, looking upstream - rocky bottom of stream with trees on either side

16) Ceanothus rodericki - showing near-prostrate habit; summit of Pine Hill, Eldorado Co.

17) Ceanothus rodericki - fruiting branch

18) Fremontodendron decumbens - flowering branch; along road near top of Pine Hill

19) Galium californicum ssp sierrae - flowering individual; hillslope just above road, near top of Pine Hill

20) Phacelia stebbinsii - non-flowering plant, showing characteristic leaf lobes; Leonardi Springs area, Eldorado Co.

21) Phacelia stebbinsii - flowering plant

22) Phacelia stebbinsii - flowering plant

23) Senecio layneae - general aspect of plant; hillside near junction of Bear Creek Rd and Meadowbrook Road, between Georgetown and Placerville.

24) Senecio layneae - flowering peduncles

25) Wyethia reticulata - young vegetative plant; downslope of road, near top of Pine Hill

26) Wyethia reticulata - plant with flowering peduncle

APPENDIX P
ENDANGERED SPECIES

Attachment 3

Species Accounts and Impact Assessment For Swainson's Hawk
and the Giant Garter Snake

SWAINSON'S HAWK SPECIES ACCOUNT AND IMPACT ASSESSMENT
AMERICAN RIVER WATERSHED INVESTIGATION

SWAINSON'S HAWK

STATUS: Swainson's hawk (Buteo swainsoni) is a state-listed threatened species and a federal candidate 2 species.

DESCRIPTION: Swainson's hawk is a medium-sized buteo, with long, pointed bicolored wings, and a square tail. The adult female weighs between 28 and 34 ounces and the male weighs between 25 and 31 ounces. The wingspan on the adult hawk is approximately 4 feet. The Swainson's hawk plumage is variable in color, and characterized by light, dark and rufous color phases. The tail is gray and barred. The sexes are generally similar in appearance; however, the females tend to be larger than the males (Clark and Wheeler 1987).

DISTRIBUTION AND ABUNDANCE: Swainson's hawk is a long-distance migrator, with nesting grounds in western North America and wintering grounds in South America, primarily Argentina, Brazil, and Uruguay. Swainson's hawk breeds throughout most of the arid region of North America west of the Mississippi, from northwestern Mexico and Baja California north to Alaska (American Ornithologists' Union 1957; Detrich 1986).

In California, Swainson's hawks were historically common throughout non-forested lowlands, absent only from the Sierra Nevada, north coast ranges, Klamath Mountains, and portions of the desert regions (Bloom 1980). Today, the range is restricted to the Central Valley and portions Modoc, Siskiyou, and Lassen Counties in the Great Basin region of northeastern California (California Department of Fish and Game 1990a; Estep 1989), with the major concentrations centered in Yolo, Sacramento, and San Joaquin Counties (Schlorff and Bloom 1984; Detrich 1986).

Historically, the Swainson's hawk population in California may have exceeded 17,000 breeding pairs, based on an historical range of 47,600 mi^2 and a maximum density of 36 breeding pairs/100mi^2 (Bloom 1980). However, current population estimates are about 550 pairs (California Department of Fish and Game 1990a). Within the Central Valley, the estimated Swainson's hawk breeding population is 280 nesting pairs.

In the Sacramento area, nesting is fairly common along the Sacramento River, the American River, and Cache Creek and its tributaries (Estep 1989). During the 1990 breeding season, 23 Swainson's hawk nesting territories were identified in the vicinity of the Natomas area along the Sacramento River (north of Discovery Park). Eleven nests were located on the Yolo County side of the Sacramento River and 12 nests were found on the Sacramento County side of the river (U.S. Fish and Wildlife Service 1990a-d). During the 1990 breeding season, successful nesting occurred in 8 of 11

nests along the west side of the Sacramento River, but in only 4 of 12 nests in the Natomas area.

The lower American River contains numerous areas that could provide potential nesting habitat for Swainson's hawk, however, due to the high level of human disturbance, and lack of sufficient foraging habitat, which has been estimated by USFWS (1990) to be approximately 836 acres (430 acres in grassland, 170 acres in grain production, and 236 acres in pasture), it is unlikely that the hawks nest or forage extensively in this ares. Historically, Swainson's hawk were sighted in the vicinity of the American River Parkway and were observed nesting at Discovery Park in 1975 and 1975 (Vincenty, 1974; Johnson, 1985 in Sanders et al. 1985). However, since that time, there have been no reports of nesting along the lower American River (DFG, 1991; USFWS, 1990-a; Flannery, no date).

Swainson's hawk have been reported as rare visitors in the Sierra Nevada (Beedy and Granholm, 1985; Verner, et al; Orr and Moffit, 1971), where they are thought to forage in high meadows prior to southward migrations in fall, or as local movements of birds from the east slope. No records of breeding in the foothills or mountains could be found, and it is assumed that appropriate nesting habitat is rare or absent.

BREEDING BIOLOGY: Swainson's hawk arrive in the Central Valley between late March and early April to establish breeding territories. Males and females, which are monogamous until the loss of a mate, arrive simultaneously to traditional territories (Woodbridge 1983). However, nesting trees may vary between years within the traditional territories (Estep 1989). It is a late nester, establishing nests about a month later than the red-tailed hawk (Buteo jamaicensis), where the species are sympatric.

Nesting generally starts in May, with typical clutches ranging from 1 to 4 eggs (Olendorff 1972). Incubation lasts from 28 to 35 days, and the nestlings are fledged at between 4 and 8 weeks of age (Beebe 1974; Detrich 1986).

NESTING HABITAT: The Swainson's hawk nests throughout the Central Valley in solitary trees, small groves, or shrubs adjacent to open grasslands or agricultural fields (Dunkel 1977; Bloom 1980; Woodbridge 1983; Schlorff and Bloom 1984; and Estep 1989).

Much of the nesting habitat in this area is associated with riparian forests. Schlorff and Bloom (1984) reported that 82 percent of the nests were located in, or within one mile of riparian forests, while Estep (1989) found 78 percent of Swainson's hawk nests in riparian areas. Favored nesting trees include valley oak (Quercus lobata), Fremont cottonwood (Populus fremontii) (Schlorff and Bloom 1984); however, eucalyptus (Eucalyptus spp.), sycamore (Platanus racemosa), walnut (Juglans spp.), and willow (Salix spp.) may be utilized to a lesser extent (Detrich 1986). Nests are usually located near the top of the tallest tree in an

area approximately 20 to 90 feet above ground where shade is provided along with a good view of the surrounding terrain (Mallette and Gould 1978; Schlorff and Bloom 1984). The average tree and nest height of 40 Swainson's Hawk nests in Yolo, Sacramento, and San Joaquin counties were 57.7 feet and 47.2 feet, respectively (Estep 1989). Nest locations are generally within easy flying distance to agricultural fields with abundant and available prey.

FORAGING HABITS AND HABITAT: Foraging habitat includes native grasslands, lightly grazed pastures, alfalfa and other hay crops, tomatoes, beets, and a combination of row crops. Telemetry studies in the mid-valley area indicate that the feeding habitat of Swainson's hawk was, in order of preference, alfalfa, disced fields, fallow fields, dry-land pasture, beets, tomatoes, irrigated pasture, grains, other row crops, and other agricultural lands (Estep 1989). Unsuitable foraging habitat includes rice fields, orchards, vineyards, and cotton crops in which the vegetative cover precludes sighting of prey (California Department of Fish and Game 1990a).

Major prey includes rodents, such as squirrels, mice and gophers; birds, such as meadowlark, pheasant, and mourning dove; and insects, such as grasshoppers and crickets. Foraging range is dependent on the abundance and availability of prey. In central California, foraging range varied from 30 and 16,000 acres, with distances up to 18 miles from the nest (Estep 1989). These number differ considerably from home range studies conducted in other areas of the western U.S. Craighead and Craighead (1956) recorded maximum foraging areas in Wyoming ranging between 180 to 1056 acres. Newton (1979) compiled data on separate studies conducted in Utah (Smith and Murphy 1973) and Wyoming (Dunkle 1977; Craighead and Craighead 1956) and reported that the home range Swainson's hawk nesting pairs averaged between 1200 and 1600 acres (3-4 km/pair). Studies conducted by Bechard (1982) in Washington found Swainson's hawk home ranges were between 1500 and 3200 acres. Bechard (1982) also reported a significant positive correlation ($r=0.97$, $df=3$, $P<0.01$) between the size of the home range and the amount of cultivated land it contained. Those home ranges with uncultivated pasture or left fallow presumably increased prey vulnerability and decreased the area required to forage. The high foraging acreage reported by Estep (1989) may be attributable to a higher percentage of cultivated lands.

Trapping studies conducted by Estep (1989) found that tomato fields had the highest capture rates of small mammals (22.1 percent), followed by sugar beets (19.9 percent), edge habitat (19.6 percent), fallow fields (10.3 percent), dryland pasture (10.3 percent), alfalfa (7.2 percent), riparian (3.7 percent), etc. However, Bechard (1982) noted the hunting sites of Swainson's hawk in Washington State were a function of prey vulnerability rather than prey density. Field observations of radio-tagged Swainson's hawk in California indicate that over 50 percent of observed foraging time and 73 percent of successful prey captures were

conducted during certain field practices, such as harvesting, discing, mowing, flood irrigating, and agricultural burning, in which cover was removed or prey otherwise disturbed and, thus, more vulnerable to predation (Estep 1989). Swainson's hawk actively searched in concert with farm equipment. Unless field activities were being conducted, Swainson's hawk would spend little time on a single field before moving on in search of prey. This highly active foraging behavior results in birds traveling as far as 18 miles in search of food (Estep 1989).

The U.S. Fish and Wildlife Service (1986) noted that abundance of food is the most important factor determining the abundance of hawks. In northern California, Woodbridge (1983) reported that Swainson's hawk prey consisted of small mammals (60 percent), birds (25 percent), and reptiles and insects (14 percent), with Belding's ground squirrel comprising the greatest biomass. In the mid-Central Valley area, pellet analysis conducted by Estep (1989) found that small mammals accounted for 21.7 percent of total prey and 43.5 percent of total biomass; birds constituted 10.8 percent of total prey and 49.8 percent of total biomass; reptiles and amphibians accounted for 0.6 percent of total prey and 1.3 percent of total biomass; and invertebrates (insects and crustaceans) accounted for 66.8 percent of total prey and 5.4 percent of biomass. The U.S. Fish and Wildlife Service (1986) has suggested that insects may be underrepresented in prey studies due to ease of digestion. Insects are particularly important as food for fledglings (Detrich 1986).

OVERWINTERING: Swainson's hawks migrate to wintering grounds in impressive flocks (American Ornithologists' Union 1957), with the peak migration period in September (Woodbridge 1983). Swainson's hawk spend about seven months on their winter feeding grounds or in migration. The primary wintering range is in Argentina, with subordinate winter range in Uruguay, Paraguay, Boliva, Brazil, Peru, Ecuador, Columbia, and Venezuela (U.S. Fish and Wildlife Service 1986).

ENDANGERMENT: Many factors have been postulated as possible causes for the declining populations of Swainson's hawk in California. These include incompatible vegetative cover for the production and/or capture of prey (Bloom 1980), grazing pressure (Detrich 1986), predation from great horned owls and crows (U.S. Fish and Wildlife Service 1986), depredation by humans on wintering grounds (Bloom 1980), pesticide use (Bloom 1980, Detrich 1986), and loss of breeding and foraging habitat through land use conversions (California Department of Fish and Game 1990a).

Craighead and Craighead (1956) observed that Swainson's hawks were in direct competition with the more aggressive red-tailed hawk (Buteo jamenensis), and was forced to use inferior nest sites. As a result, productivity may have been affected, since red-tailed hawk nesting success, as measured from eggs laid to successfully fledged young, was 75 percent versus 43 percent for Swainson's Hawk (Craighead and Craighead 1956).

Several factors have been recently investigated as potential causes for the decline of Swainson's hawk in California, including shell thinning secondary to organochlorine burdens, excessive biocide exposure, depredation on wintering grounds, interspecific competition, and habitat loss and/or modification (Risebrough et al. 1979).

Two factors, habitat loss and pesticide residues, may be plausible explanations; however, Risebrough et al. (1989) concluded that as yet unidentified local factor(s) are responsible for the decline. The authors noted that much of the former breeding habitat in the Central Valley has been lost to agricultural conversions. However, in some areas, the breeding populations have declined without any appreciable environmental change and large areas of formerly occupied breeding habitat in the Central Coast Ranges, the Mojave Desert, the Great Basin, Owens Valley and the Southern California coast area still exist. As a result, it was concluded that habitat destruction may be a contributing factor in the Central Valley, but it is not the principal reason for extirpation in the southern half of California.

BASELINE CONDITIONS: The suitability of foraging cover for the Swainson's hawk in the Natomas area is based on both the quantity and quality of the cover. Crop acreage were estimated by the U.S. Fish and Wildlife Service (1990) for the Natomas area (Table 1). The quality of each cover type was evaluated in terms of the habitat preference ranking system developed by Estep (1989) for Swainson's hawks in the mid-Central Valley area (Table 1). Assuming that habitat categories 1 through 8 represent potentially suitable habitat, then the Natomas area would presently contain approximately 12,620 acres of habitat suitable for Swainson's hawk.

Based on the average home range of 6,818 acres/pair reported by Estep (1989), the Natomas area could support about 2 breeding pairs. However, 12 nesting territories were identified in the area in 1990 of which four successfully fledged young (Table 2). This would suggest either that the nesting territories within Natomas are smaller than the average reported by Estep (1989), or that the nesting pairs forage more intensely outside of the Natomas area. A combination of these two factors could also be the cause. Using the minimum forage area of 1200 acres recommended by DFG-Region 2 (California Department of Fish and Game 1990b) for mitigation, the Natomas area could potentially support approximately 10 breeding pairs, which is consistent with the number of nesting pairs observed in 1990, and consistent with range of acreage figures reported by others (Craighead and Craighead 1956; Newton 1979; Bechard 1982).

Therefore, for the purpose of analyzing potential indirect impacts of future growth in the Natomas area on Swainson's hawk, it will be assumed that the potentially critical limiting factor is the availability of adequate foraging cover (e.g., categories 1-8). Further, an average of 1200 acres will be required for each breeding pair. As suggested by the number of nesting attempts in

the Natomas area, nesting habitat is not a limiting factor.

TABLE 1. Estimated Crop Acreage and Suitability Rating for Forage Cover for Swainson's Hawk in the Natomas Area

CROP	SACRAMENTO COUNTY[1]	SUTTER COUNTY[1]	TOTAL BY CROP	HABITAT RATING[3]
Alfalfa	830	152	982	1
Sugar Beets	2510	1099	3609	5
Tomatoes	1124	124	1248	6
Wheat	3056	1268	4324	8
Corn/Grain	1995	458	2453	8
Safflower	2019	634	2653	9
Rice	9620	14017	23637	10
Orchard[2]	83		83	10
TOTAL	21237	17752	38989	

[1]U.S. Fish and Wildlife Service, 1990
[2]County of Sacramento, 1990
[3]Estep, 1989

TABLE 2: Nesting Success of Swainson's Hawk in the Vicinity of the Natomas Area, 1990

STATION	JUN 1990	JUL 1990	AUG 1990	SEP 1990
60.5L	pair and nest confirmed	nest with 2 young	2 fledged	pair gone
64.5L	pair and nest confirmed	nest abandoned		pair gone
65.3L	pair and nest confirmed	inactive pair		pair gone
66.2L	pair and nest confirmed	left territory		pair gone
66.8L	pair and nest confirmed	nest abandoned		pair seen on 9/7/90
68.4L	pair and nest confirmed	inactive pair		pair gone
72.1L	pair and nest confirmed	2 hatchlings	2 fledged	adults and juveniles near nest
73.0L	pair and nest confirmed	possible nest failure		no hawks near nest
74.8L	pair and nest confirmed	possible nest failure		
75.4L	pair and nest confirmed	possible nest failure		no hawks near nest
77.0L	pair and nest confirmed	3 hatchlings	3 fledged	adults and juveniles near nest
79.1L	1 bird, nest unconfirmed	1 hatchling fledged	1 fledged	adults and juveniles near nest
61.5R	pair and nest confirmed	2 nestlings	2 fledged	pair seen to 9/7
65.8R	pair and nest confirmed	1 branchling fledged		pair seen to 8/31
66.2R	pair seen, nest not confirmed	inactive pair		pair seen to 9/7
68.7R	pair and nest confirmed	1 young produced, adults left nest	hatchling died due to abandonment	
69.4R	pair seen, nest not confirmed	1 fledgling		
69.6R	pair and nest confirmed	1 branchling fledged	1 fledged	1 adult seen on 8/31.
69.8R	pair and nest confirmed	no young, nest abandoned		pair seen to 9/7
70.5R	pair and nest confirmed	1 nestling	1 fledged	pair not seen since 7/24
74.1R	pair seen, nest not confirmed	1 nestling	1 fledged; other fledglings in area	fledglings in area
77.5R	pair and nest confirmed	3 branchlings fledged		pair and young seen near nest

Source: USFWS (1990a-d)

PROJECT IMPACTS

NO ACTION - DIRECT IMPACTS

Natomas, Lower American, Upper American River. Under the no action alternative, no federal or state action would be undertaken to modify the existing flood control system. Therefore, no direct impacts on Swainson's hawk would occur.

NO ACTION - INDIRECT IMPACTS

Natomas, Lower American River. Assuming the principal cause for the decline of Swainson's hawk in the Central Valley is the conversion of suitable nesting and foraging habitat into incompatible land uses, then the impacts of the no action

alternative would potentially involve two factors: (1) urbanization allowable under flood plain guidelines and, (2) production of crops incompatible with Swainson's hawk foraging.

Consistent with the no-action land use projections, no conversion of agricultural lands to alternative land uses would occur after October 1, 1992 when the current FEMA moratorium expires. Up to 1992, approximately 100 acres of agricultural land in South Natomas and 200 acres of agricultural lands in North Natomas would be converted to non-agricultural land uses. Based on the Swainson's hawk foraging habitat requirements cited above, the loss of 300 acres or 25 percent of an average home range is unlikely to represent a significant loss of forage habitat, since sufficient foraging habitat to compensate for this loss is located within the normal foraging range of Swainson's hawk. Further, future development in the Natomas area would require compliance under the California Endangered Species Act (CESA) and the California Environmental Quality Act (CEQA) and mitigation for lost foraging area would normally be required unless overriding considerations were invoked.

With respect to alternative cropping patterns which may be incompatible with Swainson's hawk foraging strategies, no statutory prohibition exists for the change in crop production. Rather, such decisions are based on regulatory policy and market factors, making reliable predictions concerning the expansion or contraction of Swainson's hawk habitat problematic. To illustrate this point, consider rice, which is known to be incompatible with Swainson's hawk foraging. If, at some future time, federal price supports were eliminated such that it was not economically feasible to produce the crop, conversion to alternative crops would be likely. If suitable crops were produced, this could potentially increase the foraging habitat by up to 25,000 acres, and support over 20 breeding pairs. If, on the other hand, new markets were opened up, or demand was stimulated in existing markets, rice prices would rise, and lands currently compatible with Swainson's hawk foraging could be converted to rice production.

Coupled with these factors is the uncertainty concerning the precise cause(s) of the Swainson's hawk decline. As a result, prediction of future without-project impacts on Swainson's hawk is unreliable and speculative. However, to facilitate analysis of with-project impacts, it will be assumed that only future land use conversion will impact the Natomas population. It must be remembered that, given the current state of knowledge, there is no assurance that habitat preservation will, in fact, result in sustainable breeding populations.

Lower American River. The lower American River contains numerous areas that could provide potential nesting habitat for Swainson's hawk, however, due to the high level of human disturbance, and lack of sufficient foraging habitat, which has been estimated by USFWS (1990) at 836 acres (430 acres in grassland, 170 acres in grain production, and 236 acres in

pasture), it is unlikely that the hawks nest or forage extensively in this area. Further, no change in the land use is expected along the lower American River because of its protected status as a county park and its protected status as a wild and scenic river through the Federal government and State of California.

While not technically within the lower American River Parkway, there is approximately 1100 acres of vacant, undeveloped land within the 100-year flood plain south of Meadowview Road in south Sacramento. Considerable nesting activity was observed along the Sacramento river in this area in 1990 (USFWS 1990 a-d). between river mile 47.2 and 52.7, a total of 6 Swainson's hawk nests were found (5on Yolo County side of Sacramento River and 1 on Sacramento County side). Of the 6 nests, 2 successfully fledged young. Under the no action plan, this vacant land would not be developed and, therefore, continue to provide foraging habitat sufficient to support about 1 pair of Swainson's hawk. As a result, no impacts are expected under no action alternative.

Upper American River. Swainson's hawk is not expected to nest or forage within the impact zone of the proposed project.

SELECTED PLAN - DIRECT CONSTRUCTION IMPACTS

Natomas. Approximately 626 acres of predominantly agricultural lands will be acquired in fee title or easement for the construction of new levees or modification of existing levees in the Natomas area. Modification of these areas could potentially result in the loss of 50 percent of an average Swainson's hawk breeding pair home range.

Construction activities for the selected plan are not expected to have any direct impact on nesting habitat sites, since all proposed construction sites area greater than 0.5 miles from existing nest sites. Further, construction will not require the removal of potential nesting trees.

Lower American River. No construction activities are anticipated along the lower American River.

Upper American River. Swainson's hawk is not expected to forage or nest within the impact zone of the proposed flood control dam, consequently no construction impacts are anticipated.

SELECTED PLAN - DIRECT OPERATIONAL IMPACTS

Natomas. Operational impacts associated with the selected plan involve maintenance activities during non-flooding periods, and pumping activities during flood periods. Maintenance activities include inspection and repair of levees, and periodic removal of woody vegetation from the levee side slopes. Potential impacts on Swainson's hawk, either positive or negative, would be

dependent on the timing and nature of the levee maintenance. For example, periodic mowing of the levee slopes would benefit Swainson's hawk by increasing the vulnerability of prey similar to the situation described by Estep (1989) in which Swainson's hawks were frequently observed following farming equipment that was exposing prey. Further, the removal of shrub vegetation would also benefit Swainson's hawk by increasing the amount of forage habitat. However, if mowing activities were conducted in the fall after the departure of the species in fall, no benefit would be derived.

<u>Lower American River</u>. No operational actions are included under this alternative for the lower American River.

<u>Upper American River</u>. Swainson's hawk is not expected to forage or nest within the impact zone of the flood control dam, consequently no construction impacts are anticipated.

SELECTED PLAN - INDIRECT IMPACTS

<u>Natomas</u>. Based on the approved local general and specific plans for the various jurisdictions in the Natomas area, it is expected that approximately 8621 acres of land currently in agricultural production would be converted to alternative land uses by the year 2010. It is probable that some of this land is not presently compatible with Swainson's hawk foraging activities; however, the actual breakdown is not known. It is therefore assumed that the proportion of compatible to incompatible lands among the 8621 acres that will be lost is the same as the compatible/incompatible proportion on existing agricultural lands. At present, of the 38,989 cropped acres in the Natomas area, 26,373 acres, or approximately 66 percent, are not generally utilized by the Swainson's hawk. As such, of the 8621 acres of agricultural land expected to be converted, approximately 2845 acres would represent a similar proportion of potential Swainson's hawk forage habitat. Such a loss would represent sufficient acreage to support two breeding pairs of Swainson's hawk. Therefore, the loss would be significant and would likely constitute a taking under the California Endangered Species Act (CESA).

The build-out scenario between the year 2010 and the end of the economic life of the project is highly speculative at this time since growth projections and land use planning beyond the current and draft plans have not been initiated by the local jurisdictions. However, if current growth trends continue, it is possible that an additional 28,000 acres of cropland could be converted to alternative land uses. Based on the proportion used above, approximately 9350 additional acres of Swainson' hawk foraging habitat could be lost. This would represent sufficient acreage to support approximately 8 nesting pairs, and would constitute a significant impact. Changes this extensive in the current land uses would require compliance with state and local planning laws, and require the development and approval of General and Specific Plans and attendant EIRs. Mitigation measures for impacts to

Swainson's hawk would be required under CEQA, unless overriding considerations were invoked. Thus, this analysis represents a worst-case scenario.

Lower American River. No indirect impacts are expected due to the protected status of the lower American River.

Upper American River. Swainson's hawk is not expected to nest or forage within the impact zone of the proposed flood control dam, consequently no impacts are anticipated in the area. However, approximately 1100 acres of vacant, undeveloped land exists within the 100-year flood plain south of Meadowview road in south Sacramento. This vacant land would be protected from flooding by the flood control dam and, therefore, could potentially be lost as foraging habitat. Based on the ratio of 1 nesting pair/1200 acres, this conversion could potentially result in loss of habitat sufficient to support about 1 pair of Swainson's hawk.

SELECTED PLAN - MITIGATION MEASURES

Direct Impact Mitigation.

1. All Swainson's hawk foragable habitat that is temporarily disturbed by construction activities should be reseeded/replanted with vegetation deemed appropriate by DFG for Swainson's hawk foraging.

2. All project construction areas determined to be foragable habitat for the Swainson's hawk that will be permanently lost as a result of construction activities should be mitigated through the permanent acquisition and maintenance of an equal area of forage-compatible habitat in a manner acceptable to DFG.

3. Because all presently known construction sites are located a minimum of one mile from the site of active Swainson's hawk nests (the closest nest to proposed construction activity is at RM 77.5R), potential disturbance to nesting hawks would be insignificant. However, in the event nest(s) are established at new sites within 1/2 mile of proposed construction sites, or if new construction sites are identified within 1/2 mile of currently known Swainson's hawk nests, such work will be deferred until after the departure of the hawks in the fall, unless it is determined by DFG that proposed construction activities would not impose serious impacts to nesting hawks.

Indirect Impact Mitigation

All future development in the Natomas area will be preceded by mandatory environmental review consistent with state law (CEQA, CESA, etc.) and local planning policies. In order to prevent development on the former Natomas Basin flood plain from triggering jeopardy decisions concerning Swainson's hawk, it is recommended

that the following measures be adopted by the local agencies (City of Sacramento, County of Sacramento, and County of Sutter):

1. In conjunction with the Sacramento Urban Flood Control Project, the continued monitoring of the breeding activity of the Swainson's hawk in the vicinity of the project should be continued. In addition, monitoring efforts should be expanded to include investigation of the foraging habitats utilized by Swainson's hawk in the Natomas area.

2. In coordination with DFG, the local agencies should identify and inventory parcels of land that are currently suitable as Swainson's hawk foraging habitat, based on known habitat and cover crop preferences.

3. It should be an adopted goal of the local agencies to take prudent and reasonable measures to maintain existing stocks of breeding Swainson's hawks in the Natomas area. Potential means to accomplish this goal include the following:

    a. Preservation and maintenance of a one-mile-wide habitat set-aside east of, and immediately adjacent to, the Sacramento River from the north side of the confluence of the Sacramento and American Rivers north to the south side of the Natomas Cross Canal. Preservation could be accomplished through acquisition by fee title or easements or zoning as a "Habitat Conservation Zone" or agricultural preserve. Steps would have to be taken to assure that these zoning designations could not be subsequently changed. Mechanisms, such as a transfer of development rights (TDR) system, could be to implement a set-aside. Such a measure would require the acquisition of approximately 10,900 acres. Most of the land in this buffer area is currently designated for agricultural use. Draft land use plans contained in the South Sutter County General Plan Amendment Initial Study (1990) indicate these lands would remain in agricultural use, and the Open Space Element of Sacramento County's Draft General Plan (1990) indicates the Sacramento County portion would remain as Open-Space and designated as Airport Buffer Lands and/or Airport Approach Lands. As such, urbanization would be an inconsistent land use, whereas habitat preservation would be a compatible land use. Adoption of this measure would result in consistent and conjunctive mitigation, resulting in distribution of costs over an array of mitigation purposes, including habitat conservation, noise, open space, and agricultural preservation.

b. Establishment of a mitigation bank and assessment district for the replacement of lost Swainson's hawk foraging habitat on an acre-for-acre basis for individual projects. Under this scheme, the local agencies would, in consultation with DFG, designate and zone large parcels of land suitable as Swainson's hawk foraging habitat. Each approved development would require the purchase of an equivalent acreage of foraging habitat within these designated habitat conservation areas on an acre-for-acre basis. In the event that insufficient acreage of suitable foraging habitat exist to accommodate planned development, then it would be necessary to convert previously unsuitable lands, such as rice fields, into appropriate cover. In addition, a mitigation assessment district would be established to provide a source of continuous funding to maintain the mitigation lands.

150-YEAR ALTERNATIVE - DIRECT CONSTRUCTION IMPACTS.

Natomas. See impacts described for the selected plan.

Lower American River. Construction activities involving Folsom Dam and the levee system along the lower American River would not impact Swainson's hawk due to the lack of sufficient acreage to support nesting.

Upper American River. The upper American River canyon does not provide suitable habitat to support Swainson's hawk, further, no construction activities would be performed in the upper American River under this alternative. Therefore, no impacts would be expected.

150-Year Alternative - Direct Operational Impacts.

Natomas. See impacts described for the selected plan.

Lower American River. Operational activities for this alternative would involve the seasonal increase in the flood water reservation pool in Folsom Reservoir on an annual basis. During flood periods, increased discharges down the lower American River would increase from 155,000 cfs to 180,000 cfs. Because these operational conditions would occur during the rain season when Swainson's hawk would be on wintering grounds in South America, no direct operational impacts would result.

Upper American River. The upper American River canyon does not provide suitable habitat to support Swainson's hawk, further, no construction activities would be performed in the upper American River under this alternative. Therefore, no impacts would be expected.

150-YEAR ALTERNATIVE - INDIRECT IMPACTS

Natomas. See impacts described for the selected plan.

Lower American River. This alternative would not impact the lower American River Parkway. However, the increase in the level of flood protection in the City of Sacramento and the County of Sacramento could permit future development. Approximately 1100 acres of potential Swainson's hawk nesting and foraging habitat within the flood plain south of Meadowview Road would be protected from the 100-year flood could be developed under this alternative. Using the 1200 acre/breeding pair value, development of this land could potentially result in the loss of habitat sufficient to support 1 pair of Swainson's hawk.

Upper American River. The upper American River canyon does not provide suitable habitat to support Swainson's hawk, therefore, no impacts would be expected.

150-YEAR ALTERNATIVE - MITIGATION MEASURES.

Natomas. See direct and indirect mitigation measures described for the selected plan.

Lower American River. Consistent with the measures described for direct and indirect mitigation for the selected plan, establishment of a set-aside from the replacement of essential Swainson's hawk foraging habitat should be implemented on a acre-for-acre basis coincident with urban development of these lands.

Upper American River. No mitigation would be required.

100-YEAR ALTERNATIVE - DIRECT CONSTRUCTION IMPACTS

Natomas - See impacts described for the selected plan.

Lower American River. The 100-year alternative does not involve any construction activities along the lower American River, nor does the area contain suitable habitat to support the Swainson's hawk occupancy. Therefore, no impacts are expected.

Upper American River. See impacts described for the 150-year alternative.

100-YEAR ALTERNATIVE - DIRECT OPERATIONAL IMPACTS.

Natomas. See impacts described for the selected plan.

Lower American River. Operational activities for this alternative would involve the seasonal increase in the flood water reservation pool in Folsom Reservoir on an annual basis. These operational conditions would occur during the rain season when

Swainson's hawk would be on wintering grounds in South America, therefore, no direct operational impacts would result.

Upper American River. See impacts described for 150-year alternative.

100-Year Alternative - Indirect Impacts.

Natomas. See impacts described for the selected plan.

Lower American River. See impacts described for the 150-Year Alternative.

Upper American River. See impacts described for 150-year alternative.

100-Year Alternative - Mitigation Measures.

Natomas. See direct and indirect mitigation measures described for the selected plan.

Lower American River. See direct and indirect mitigation measures described for the selected plan.

Upper American River. No mitigation would be required.

GIANT GARTER SNAKE

STATUS: The giant garter snake (Thamnophis couchi gigas) is listed as a Threatened species by the State of California and a Category 2 Candidate species by the federal government.

DESCRIPTION: The giant garter snake (GGS) is one of the largest garter snakes, reaching up to 4.5 feet in length. It is dull brown in color with a checkered pattern of well separated black spots on the dorsum, a dull yellow dorsal stripe, and lateral stripes which are undeveloped. It has an elongated head with a pointed muzzle (California Department of Fish and Game 1990a).

DISTRIBUTION: Historically, the reported range of the GGS included the Central Valley from the vicinity of Sacramento and Antioch southward to Buena Vista Lake near Bakersfield in Kern County (Hansen and Brode 1980). The present known distribution extends from just south of Chico in Butte County southward to the vicinity of Burrel in Fresno County (Ellis 1987).

The population size of the GGS is unknown in the Natomas area; however DFG is in the process of performing a study in cooperation with Caltrans to estimate the Natomas Basin population (John Brode, CDFG, pers. comm., 1991). It is likely that most or all waterways in this area are frequented by the GGS as this area is the most important location for the species in terms of interbreeding between northern and southern populations.

The GGS has not been reported in the foothills of the Sierra Nevada (Basey and Sinclair, 1980; Hansen and Brode, 1980) and is not likely to be found in the upper American River canyon due to the absence of required habitat. The GGS has also not been reported along the lower American River (DFG, 1991; Sanders et al, 1985; Hansen and Brode, 1980). The GGS has been reported within areas of the 100-year flood plain in the south Sacramento area (Hansen, 1982; Hansen and Brode, 1980).

HABITAT: GGS typically inhabits sloughs, marshes, and drainage canals characterized by slow flowing or standing water, permanent summer water, mud bottoms, earthen banks, and an abundance of preferred forage species. GGS are highly aquatic, but avoid areas of dense riparian overstory, preferring instead emergent aquatic vegetation, such as tules and cattails, and herbaceous terrestrial cover composed of annual and perennial grasses, blackberry, and mustard (CNDD 1989). This vegetation, along with burrows, undercut banks, and large rocks, provide escape cover (J. Brode pers. comm., 1990). In addition, areas devoid of overstory shading are required for basking areas for thermoregulation. Rice fields have been found to be more important in recent years and females use these fields as nursery areas in mid-summer (J. Brode, pers comm, 1990). Elevated features are necessary for refugia in areas subject to winter flooding (CDFG 1990a). GGS are generally absent from areas occupied by large, exotic predatory fish, such as black bass and

striped bass. GGS also avoid larger bodies of open water and areas where the banks are only lightly vegetated (CDFG 1990a).

GGS rely on canals and ditches as movement corridors. These movement corridors are vital to migration patterns and, most importantly, for continuing genetic exchange between subpopulations. It is unknown how far GGS travel in a given time frame; however they have been observed to travel in small irrigation ditches, suggesting that they have traveled a significant distance from the main canals (J. Brode, pers. comm. 1991).

OVERWINTERING: GGS are active between early April to mid-October. After the first part of October, GGS begin to search for suitable winter retreats where they remain all winter (Brode 1990).

FEEDING HABITS: GGS is an aquatic feeder that specializes in ambushing fish underwater. It generally feeds on small carp (Cyprinus carpio), bullhead (Ictalurus sp.), mosquitofish (Gambusia affinis), and minnows. It will also feed on bullfrog (Rana catesbeiana), Pacific treefrog (Hyla regilla), and tadpoles (Hansen 1982, 1986)

ENDANGERMENT: GGS faces endangerment from three primary factors: continued urbanization, agriculture, and the introduction of predatory and/or competitive species (Ellis 1987). Urban development has dramatically changed its habitats through pollution, destruction of prey availability, and conversion of preferred native vegetation to exotic landscapes. Wetlands have been drained and streams have been rerouted through pipes or concrete channels to create sites for urban development and agriculture.

GGS are also lost as a direct result of farming operations. Livestock grazing has depleted protective plant cover and compacted the soil resulting in the destruction of underground retreats. The introduction of large predatory fish species into almost all permanent freshwater environments has effected the giant garter snake by preying on young snakes and competing for smaller forage fish (Ellis 1987).

BASELINE CONDITIONS: The present population of the GGS in the Natomas area is unknown, however, it is believed to be widespread in the area due to the abundance of suitable habitat. Studies are currently being performed to address the question of the size of the Natomas population.

In the absence of empirical data regarding the population size and distribution of GGS in the Natomas area, this analysis will assume that preferred habitat supports GGS and any loss of preferred habitat would impart significant impacts to GGS.

While no likely to be found in the upper American River canyon or along the lower American River, the GGS has been reported in other

areas of the 100-year flood plain. Hansen and Brode (1980) reported 5 observations of GGS in south Sacramento County. Hansen (1982) observed the GGS along Elk Grove and Laguna Creeks in southern Sacramento County. Hansen (1982) had attributed low densities to the effects of winter flooding and heavy grazing. Hansen noted that GGS also inhabit the Stone Lake and Beach Lake areas.

PROJECT IMPACTS

NO ACTION - DIRECT IMPACTS

Natomas, Lower American, Upper American River. Under the no action alternative, no federal or state action would be undertaken to modify the existing flood control system.

In areas inhabited by the GGS within the 100-year flood plain, winter flooding caused by the lack of adequate flood protection could result in significant impacts to individual GGS in retreats situated below flood level. Hansen (1982) has identified winter flooding as a potential reason of low GGS populations along Laguna and Elk Grove Creeks. Those snakes which evacuate flooded hibernacula are more vulnerable to predation by their inability to move quickly due to cold temperatures (Hansen, 1982).

NO ACTION - INDIRECT IMPACTS

Natomas, Lower American River. Based on the reported causes of GGS decline (e.g., urbanization, agricultural practices, and predation and/or competition), only urbanization would be reduced as a contributing factor for the species decline in the Natomas area. Agricultural practices would likely continue in response to market forces which could potentially increase or decrease GGS habitat. Again, using the example of rice, increased demand for rice could increase the amount of land in Natomas in rice production which would benefit GGS. Decreased demand for rice, reduced crop subsidies, etc. could also lead to the conversion of rice fields to alternative production, which could negatively impact GGS.

Upper American River. GGS does not inhabit the upper American River project area.

SELECTED PLAN - DIRECT CONSTRUCTION IMPACTS

Natomas. With the exception of the construction of the pumping plant in the NEMDC above its confluence with Dry Creek, all construction activity would be performed on the landward side of the levee, eliminating direct impacts to the larger waterways. Toe drains located at the base of the levees would be relocated to accommodate the lateral expansion of the levees, however, because

toe drains are used for irrigation and drainage (J. Clifton, RD 1000, pers. comm. 1991), they maintain summer water, and may provide suitable habitat for GGS. The existing toe drains at proposed construction sites would be relocated adjacent to the modified levee. Approximately 5,000 linear feet of levee enlargement along the NCC would not require modification of the toe drains. Approximately 1200 feet of the NEMDC would require levee enlargement. These modifications would not involve impacts to the existing toe drains. However, the raising of the Sankey Road section of NEMDC by 4 feet for 3000 linear feet may involve relocation of the toe drains (L. Dacus, Corps of Engineers, pers. comm. 1991). It is estimated that approximately 3000 linear feet of toe drains would be relocated, which could impact GGS and will require mitigation to assure impacts are below the level of significance.

Levee enlargement along Dry Creek and Arcade Creek could involve impacts to toe drains. However, these toe drains are not used to convey irrigation or agricultural drainage flows. As a result, these drains do not contain summer water and are, therefore, unsuitable as GGS habitat.

Lower American River. No construction in anticipated along the lower American River.

Upper American River. GGS does not inhabit the upper American River project area.

SELECTED PLAN - DIRECT OPERATIONAL IMPACTS

Natomas. Operational impacts associated with the selected plan involve maintenance activities during non-flooding periods, and pumping activities during flood periods. Maintenance activities include inspection and repair of levees, and periodic removal of woody vegetation from levee side slopes. Neither activity is expected to impact GGS. Pumping of waters over the flood gate on the NEMDC will occur only during periods of flooding and all flows would be confined to the channel. Because GGS are secure in hibernacula during the winter rain season, no adverse impacts are expected. The flood control project would benefit GGS by assuring against flooding of hibernacula, which would result in the drowning of dormant snakes.

Lower American River. The selected plan would not involve any operational changes in flood control procedures along the lower American River.

Upper American River. GGS does not inhabit the upper American River project area.

SELECTED PLAN - INDIRECT IMPACTS

Natomas. The selected plan would protect the entire 55,000 acres in the Natomas Basin from flooding, thus encouraging development pressure. Without prudent planning, future development could have significant adverse impacts on GGS through impeding movement corridors, reducing compatible habitat, increasing levels of toxic substances from urban runoff, and increasing the potential for road kills.

Based on approved and draft local general and specific plans for the various jurisdictions in the Natomas area, it is expected that approximately 8621 acres of land currently in agricultural production would be converted to alternative land uses by the year 2010. However, the potential impacts of these conversions on existing drainage canals and other waterways utilized by GGS are not known and generally unspecified. It should be noted, however, that the conversion of agricultural lands to alternative land uses would not necessarily require the relocation, removal, or major modification of irrigation and drainage canals and attendant riparian and aquatic habitat. In fact, it is feasible that certain reaches of the existing drainage canals would be retained and transect urban areas to convey agricultural drainage and also to drain urban areas. Irrespective of whether drainage canals and adjacent habitat are integrated into future development plans, the critical concern affecting GGS survival would be the availability of summer flows in those canals. In those drainage canals which would continue to convey summer flows, GGS survival would be assured. But in those canals no longer utilized for agricultural drainage, and those canals which may be removed and replaced with below ground drainage, potential impacts to GGS are likely.

For those future development areas within the City of Sacramento, a comprehensive mitigation plan has been developed by the city in consultation with DFG for the North Natomas Community Drain System SEIR (City of Sacramento 1990). Similar mitigation plans would be required for future development in the Natomas portions of Sacramento and Sutter counties.

SELECTED PLAN - MITIGATION MEASURES

Direct Impact Mitigation In order to mitigate for the loss of potential GGS habitat resulting from the modification of 3000 linear feet of toe drains, the relocation of the drains and habitat replacement should be performed in the manner proscribed by DFG (Brode 1990) and recommended in the North Natomas Community Drainage System DSEIR (City of Sacramento 1990). These include the following measures:

- No grading, excavating, of filling may take place in or within 30 feet of existing GGS habitat between October 1 and May 1 unless authorized by DFG.

- Construction of replacement habitat may take place at any time of the year, but summer is preferred.
- Water may be diverted as soon as the new habitat is completed, but placement of dams or other diversion structures in the existing habitat will require on-site approval by the DFG.
- The new habitat will be revegetated as directed by DFG or as stipulated in the environmental documents.
- Dewatering of the existing habitat may begin any time after November 1, but must begin by April 1.
- Any GGS surveys required by the DFG will be completed to the satisfaction of the DFG prior to dewatering.
- All water must be removed from the existing habitat by April 15, or as soon thereafter as weather permits, and the habitat must remain dry (no standing water) for 15 consecutive days after April 15 and prior to excavating or filling the dewatered habitat.
- DFG will be notified when dewatering begins and when it is completed. DFG will inspect the area to determine when the 15-day dry period may start.

150-YEAR ALTERNATIVE - DIRECT CONSTRUCTION IMPACTS

Natomas - See impacts described for the selected plan.

Lower American River. The GGS has not been reported in the lower American River (DFG, 1991; Hansen and Brode, 1980; Sanders et al, 1985), therefore, construction activities involving Folsom Dam and the levee system along the lower American River are unlikely to impact FFS. However, in the event that construction activities would impact potential GGS habitat, appropriate mitigation measures should be employed.

Upper American River. The upper American River canyon does not provide suitable habitat to support the GGS. Further, no construction activities would be performed in the upper American River under this alternative. As a result of these factors, no impacts would be expected.

150-YEAR ALTERNATIVE - DIRECT OPERATIONAL IMPACTS

Natomas. See impacts described for the selected plan.

Lower American River. Operational activities for this alternative would involve the seasonal increase in the flood water reservation pool in Folsom Reservoir on an annual basis, and during flood periods, increased discharges down the lower American River.

Because these operational conditions would occur during the rain season when the GGS is secure in hibernacula, no direct operational impacts would result.

Upper American River. The upper American River canyon does not provide suitable habitat to support GGS, further, no construction activities would be performed in the upper American River under this alternative. Therefore, no impacts would be expected.

150-YEAR ALTERNATIVE - INDIRECT IMPACTS

Natomas. See impacts described for the selected plan.

Lower American River. Flood protection provided by this plan would remove significant areas form the 100-year flood plain, which would allow urbanization in southern Sacramento County in areas of historic GGS inhabitation. Specifically, area adjacent to Laguna Creek and Beach Lake, could be developed under this plan.

Upper American River. The upper American River canyon does not provide suitable habitat to support GGS, therefore, no impacts would be expected.

150-YEAR ALTERNATIVE - MITIGATION MEASURES

Natomas. See direct and indirect mitigation measures described for the selected plan.

Lower American River. Construction would be performed in accordance with mitigation measures discussed in the selected plan.

Upper American River. No mitigation would be required.

100-YEAR ALTERNATIVE - DIRECT CONSTRUCTION IMPACTS

Natomas. See impacts described for the selected plan.

Lower American River. The 100-Year Alternative does not involve any construction activities along the lower American River, therefore, no impacts on GGS are expected.

Upper American River. The upper American River canyon does not provide suitable habitat to support GGS, further, no construction activities would be performed in the upper American River under this alternative. Therefore, no impacts would be expected.

100-YEAR ALTERNATIVE - DIRECT OPERATIONAL IMPACTS

Natomas. See impacts described for the selected plan.

Lower American River. Operational activities for this alternative would involve the seasonal increase in the flood water reservation pool in Folsom Reservoir on an annual basis. These operational conditions would occur during the rain season when GGS is secure in hibernacular, therefore, no direct operational impacts would result.

Upper American River. The upper American River canyon does not provide suitable habitat to support GGS, further, no operational activities would be performed in the upper American River under this alternative. Therefore, no impacts would be expected.

100-YEAR ALTERNATIVE - INDIRECT IMPACTS

Natomas. See impacts described for the selected plan.

Lower American River. See impacts described for the 150-Year Alternative.

Upper American River. The upper American River canyon does not provide suitable habitat to support GGS, therefore, no impacts would be expected.

100-YEAR ALTERNATIVE - MITIGATION MEASURES

Natomas. See direct and indirect mitigation measures described for the selected plan.

Lower American River.

Upper American River. No mitigation would be required.

VALLEY ELDERBERRY LONGHORN BEETLE

STATUS: The valley elderberry longhorn beetle (Desmocerus californicus dimorphus) is a federally listed threatened species. The State of California has no special listing for this species.

DESCRIPTION: The valley elderberry longhorn beetle (VELB) is characterized by a somewhat elongate and cylindrical body with long antennae, often in excess of 2/3 the body length. Males of the VELB are stout-bodied and their elytra are coarsely punctured with a metallic-green pattern of four oblong maculations, surrounded by a bright red-orange border. Antennae are about as long as the body or slightly shorter. Body length is about 0.51" - 0.83". Females are more robust than males, with subparallel elytra. Antennae reach about the middle of the elytra, body length is about 0.71" - 0.98" (USACE 1990).

DISTRIBUTION: The VELB is endemic to moist valley oak woodlands along the margins of rivers and streams in the lower Sacramento and upper San Joaquin Valleys of California, where elderberry grows. Although the entire historical distribution of VELB is unknown, the extensive destruction of riparian forests of the Central Valley strongly suggests that the beetle's range may have shrunk and become greatly fragmented. There is little information on former abundance of VELB for comparison with current population levels.

Populations of the host plant, blue elderberry, do exist along the lower American River. Potential impacts may result from construction on the levees in this area.

HABITAT: The beetle is host specific, maturing in and feeding as adults on elderberry (Sambucus spp.). The VELB prefers to inhabit trees with a girth of 5.91" - 25.6" (USACE 1985). The host plant is generally found within riparian corridors under several canopy layers with a dense undergrowth. The upper canopy contains Fremont's cottonwood, California sycamores, willows, and valley oaks. The secondary cover consisted of box elder, Oregon ash, elderberry, and various willows. Vines are abundant in all canopy layers of the riparian forest, including wild grape, poison oak, Dutchman's pipe vine and wild clematis (USFWS 1984).

LIFE CYCLE: The exact life cycle of the VELB is unknown, but it is assumed to follow a sequence of events similar to related taxa. The VELB are first deposits its eggs in the cracks of the bark of the elderberry shrubs. After the eggs hatch the larvae bore into the pith of larger stems and roots. When the larvae are ready to pupate, they work their way up through the pith to open an emergence hole in the bark of the elderberry shrub, then return to the pith for pupation. The length of each stage has not been defined, but the entire cycle takes about 2 years. Adults emerge at the same time as the elderberry flowers. Emergence holes are generally found in elderberry stems that are 1.0" - 1.5" in diameter or larger. The presence of emergence holes is an important indicator of VELB activity.

ENDANGERMENT: The VELB faces endangerment from the loss of riparian habitat due to agricultural and urban development. Because of limited knowledge about the VELB's life cycle and its ecological requirements, precise threats to its survival are difficult to enumerate. Insecticide and herbicide use in agricultural areas may be a factor limiting the beetle's distribution.

BASELINE CONDITIONS: Present populations of the host plant, elderberry, along the lower American River were surveyed by the USFWS. Populations of elderberry was found to be common to abundant in areas along the lower American River. No surveys have been done to determine actual occurrence of the VELB in the area but it is highly probable. Any loss of the riparian corridor would result in impacts to the VELB.

There are 16,945 acres of beetle habitat in the project area. Many of the elderberry shrubs in the project area show evidence of use by the beetle. In addition, adult beetles have been observed on numerous instances on the American and Sacramento Rivers in Sacramento County. Thus, all elderberry shrubs with a stem diameter of one inch or greater in the project area are considered to be habitat for the animal. Suitable habitat was classified as follows: Category 1 - elderberry shrubs common to abundant, clumps of shrubs commonly present, typically ranging in abundance e form >5 to many shrubs per acre; Category 2 - elderberry shrubs common to infrequent, ranging from >1 shrub per acre t 5 or more per acre; and Category 3 - elderberry shrubs infrequent to rare, frequently sparse isolated or widely scattered often single shrubs typically <1 per acre. There are 1108 acres of category 1 habitat, 3872 acres of category 2 habitat, and 11,965 acres of category 3 habitat in the project area.

PROJECT AREA OCCURRENCE: There are 14 known occurrences of the beetle within the project impact area. These sites occur along the American River Parkway from the Nimbus Flat area of Lake Natomas, south to the downstream end of Goethe Park. And, along the Sacramento River from the Fremont Weir area, south to the West Drainage Canal (CNDDB 1989). Although these are the only recorded sites, there is VELB habitat all along both rivers and it will be assumed that this habitat contains VELB.

PROJECT IMPACTS

NO ACTION - DIRECT IMPACTS

The valley elderberry longhorn beetle which inhabits elderberry shrubs commonly found in riparian corridors, would be impacted during a 200-year flood event if the flood was of sufficient duration to drown the beetle or destroy the elderberry shrubs. The relationship between inundation duration and mortality for the beetle is not known.

SELECTED PLAN - DIRECT IMPACTS

The valley elderberry longhorn beetle is known to occur in the upper American River canyons, within the inundation zone of the proposed flood control dam. Table 8-2 summarizes the results of habitat mapping done on elderberry shrubs in the upper American River canyons, and reports the assumptions made concerning projected losses. Because inundation will be most frequent in the elderberry shrub's preferred habitat--immediately adjacent to the river--losses would be highest where shrub densities are also highest. Higher on the canyon walls, where shrub densities are lowest, inundation frequency and attendant shrub losses would also be low.

TABLE 8-2. Elderberry Shrub Losses in the Upper American River Canyon

Shrub Density Per Acre	Number of Acres	Inundation Frequency	Assumed Losses Per Acre	Total Assumed Losses (No. of Shrubs)
5 or more	601	Most Frequent	5	3,005
1 to 5	1,739	Intermediate	3	5,217
less than 1	1,660	Least Frequent	1	1,660
TOTALS	4,000			9,882

SELECTED PLAN - INDIRECT IMPACTS

Development in Natomas could also entail some loss of elderberry shrubs, which are habitat to the valley elderberry longhorn beetle.

SELECTED PLAN - MITIGATION MEASURES

In order to mitigate for the loss of valley elderberry longhorn beetle habitat due to project construction and operation in both the upper and lower American river areas, elderberry shrubs will be replanted according to the loss-to-replacement ratios shown in Table 8-4. Losses in the lower American River under the 150-year and all three 100-year alternatives have not been estimated, but elderberry shrubs generally occur at a rate of 5 or more per acre along the lower American River. This would require that a 5:1 replacement ratio be used for most lower American River replants. Estimated losses in the upper American River under the selected plan and the 400-year alternative are shown in Table 8-2.

The following measures will be taken to offset the adverse impacts to the beetle and its habitat:

- Acquisition of fee-title to 2,700 acres of the South Fork American River.
- Planting of 32,336 elderberry shrubs in the 2,700 acres on the South Fork American River.
- Maintenance and monitoring of the 2,700 acres for three years and at the end of that period, the non-Federal sponsor will be responsible for assuring the success of all mitigation areas for the life of the project.
- Revegetation of areas behind the flood-control dam eliminated by landslides during 200-year flood events.

Table 4. Elderberry Shrub Replacement Ratios

Shrub Density Per Acre	Loss-To-Replacement Ratio
5 or more	5:1
1 to 5	3:1
less than 1	1:1

400-YEAR ALTERNATIVE

The direct and indirect impacts associated with this alternative would be the same as those described for the selected plan.

400-YEAR ALTERNATIVE - MITIGATION MEASURES

Same as selected plan.

150-YEAR ALTERNATIVE - DIRECT IMPACTS

The direct impacts of the 150-year alternative in Natomas would be substantially the same as described under the selected plan.

Levee construction activities may result in a loss of elderberry shrubs serving as hosts for the valley elderberry longhorn beetle. This would constitute a significant impact.

Operational activities for this alternative would involve (1) an increase in the annual flood water reservation in Folsom Reservoir during the flood season, and (2) increased design flows in the lower American River during flood periods. However, changes

in the river's flow regime could impact elderberry plants, with possible loss of plants and resident beetles.

150-YEAR ALTERNATIVE - INDIRECT IMPACTS

The indirect impacts associated with the 150-year alternative in Natomas and the lower American River would be essentially the same as those described for the selected plan.

No indirect impacts would occur in the upper American River under this alternative.

150-YEAR ALTERNATIVE - MITIGATION MEASURES

Same as selected plan.

100-YEAR (FEMA) LEVEE ALTERNATIVE - DIRECT IMPACTS

Direct impacts in the Natomas area resulting from implementation of the 100-year (FEMA) alternative would be the same as those described under the selected plan. Direct impacts in the Lower American River and upper American River study areas under this alternative would be substantially the same as those associated with the 150-year alternative. No direct impacts would occur in the upper American River.

100-YEAR (FEMA) LEVEE ALTERNATIVE - INDIRECT IMPACTS

Indirect impacts in the Natomas and lower American River areas resulting from implementation of the 100-year (FEMA) levee alternative would be the same as those described under the selected plan. No indirect impacts would occur in the upper American river.

100-YEAR (FEMA) LEVEE ALTERNATIVE - MITIGATION MEASURES

Same as selected plan.

100-YEAR (FEMA) STORAGE ALTERNATIVE - DIRECT IMPACTS

Direct impacts in the Natomas area resulting from implementation of the 100-year (FEMA) storage alternative would be the same as those described under the selected plan. Direct impacts in the lower American River areas under this alternative would be substantially the same as the 150-year alternative. There would be no direct impacts in the upper American River area.

100-YEAR (FEMA) STORAGE ALTERNATIVE - INDIRECT IMPACTS

Indirect impacts in the Natomas and lower American River areas resulting from implementation of the 100-year (FEMA) storage alternative would be the same as those described under the selected plan. There would be no indirect impacts in the upper American River area under this alternative.

100-YEAR (FEMA) STORAGE ALTERNATIVE - MITIGATION MEASURES

Same as selected plan.

100-YEAR LEVEE/STORAGE AND SPILLWAY ALTERNATIVE - DIRECT IMPACTS

Direct impacts in the Natomas area resulting from implementation of the 100-year (FEMA) levee/storage and spillway alternative would be the same as those described under the selected plan. Direct impacts in the lower American River area would be substantially the same as those occurring under the 150-year alternative. There would be no direct impacts in the upper American River area.

100-YEAR LEVEE/STORAGE AND SPILLWAY ALTERNATIVE - INDIRECT IMPACTS

Indirect impacts in the Natomas and lower American River areas resulting from implementation of the 100-year (FEMA) levee/storage and spillway alternative would be the same as those described under the selected plan. There would be no indirect impacts in the upper American River.

100-YEAR LEVEE/STORAGE AND SPILLWAY ALTERNATIVE - MITIGATION MEASURES

Same as selected plan.

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PERSONAL COMMUNICATION

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SWAINSON'S HAWK AND GIANT GARTER SNAKE HABITAT CONSERVATION PLAN SCOPE OF SERVICE AND SCHEDULE

METHODOLOGY

Our proposed work program is based on the study requirements specified in the request for proposal (RFP). The following discussion outlines in detail the tasks that will be performed by the study team, summarizes the proposed number and type of project meetings, describes the reports and graphic materials that will be provided, and presents a project management and study coordination plan.

The following sections describe the tasks, products, and methodologies to be used in preparing the Threatened Species/Multiple Species Habitat Conservation Plan(s). The task outline incorporates all tasks identified in the RFP in addition to other tasks implied but not specifically mentioned in the RFP.

TASK 1: INITIATE PROJECT/COLLECT DATA

This portion of the project will begin with those tasks necessary for project initiation, including meetings with Steering Committee staff to establish a detailed schedule and refine the work scope.

Task 1A: Steering Committee and Agency Coordination Meetings

Our study program stresses working closely with the Steering Committee throughout the study. All important parts of the Plan must go through a meeting sequence to define objectives, to review alternative approaches, and to approve the final work product. EIP has extensive experience in working with local government agency groups and in coordinating plan development with the U.S. Fish and Wildlife Service (USFWS) and the California Department of Fish and Game (DFG).

We will use this initial study task to establish with the Steering Committee coordination procedures for completing the technical aspects of the study, reporting and product review procedures, and project management procedures. Desired report formats, outlines, and delivery schedules will be established. For each major work product, we propose to first submit a detailed working outline; administrative draft documents would then be prepared upon Steering Committee approval of concepts outlined. We have found that this process saves time and money, and allows maximum flexibility within the overall work program.

In preparing the HCP and related documents, we will document the decision making process through memoranda. Public and agency acceptance of the HCP will be greatly facilitated by a clear record of how the consensus is reached in selecting one plan alternative as the basis for the adopted HCP.

At the direction of the Steering Committee, we will conduct interviews with a number of "Stakeholders". These will include the USFWS, the DFG, the City of Sacramento, County of Sacramento, Sutter County, State Reclamation Board, U.S. Army Corps of Engineers, and members of the private sector. The purpose of these discussions will be to determine agency concerns and information requirements for the study as the basis for refining and guiding the scope of work.

Task 1B: Collect, Review, and Summarize Existing Data

Preparation of planning documents related to endangered species must be supported by adequate biological information. In particular, conservation plan documents must contain information on the range and population status of the species of concern, habitat type, and most importantly, the impact the plan will have on the species habitat and population.

The project team is familiar with the plan area and its physical and biological resources through direct on-site experience. Team members have written documents for the County, private developers, and other agencies in the area and have conducted vegetation and wildlife survey work over much of the study area.

We will identify the extent and location of additional existing information and data sources. This information and data will be collected and critically reviewed for technical accuracy, completeness, and applicability for our studies.

We will use all available sources to accumulate accurate information on the biological, physical, and land use resources actually present on private and public lands in the study area. Information will be sought from all of the local contact persons affiliated with governmental agencies and environmental organizations, and knowledgeable individuals identified.

Task 1C: Refine Scope of Services

EIP will meet with the Steering Committee and describe the progress achieved under Task 1. Major concerns and issues raised by the agency interviews will be identified. Any data collection gaps will be identified, and proposed scope revisions will be discussed.

Based on the foregoing discussions, the scope of our services will be modified as needed to reflect any additional required analysis. The refined scope of services will be presented to the Steering Committee as the first major product of the program — the Detailed Work Program.

TASK 2: CHARACTERIZE EXISTING CONDITIONS

The purpose of this task will be to establish and characterize existing conditions for the species of concern within the study area.

Swainson's Hawk

Task 2A: Background - Based on a review of the relevant literature, the following will be provided:

1. A description of the Swainson's hawk including:

   (a) Habits and preferred nesting and foraging habitat;

   (b) Migratory patterns and status in wintering habitat; and

   (c) Status in the western United States outside California.

2. Background information on the listing of the hawk as a threatened species in California, including:

   (a) Estimated historic population and statewide distribution;

   (b) Current status in California, including the Sacramento Valley; and

   (c) Probable causes of threatened condition.

Task 2B: Inventory of the Study Area - Based on input from DFG and the USFWS, including field surveys where necessary, the following information will be provided:

1. Inventory of nesting pairs of hawks inhabiting or foraging in the following study area:

   (a) The Natomas basin (south of the Natomas Cross Canal, east of the Sacramento River, north of the American River, and west of the Natomas East Main Drainage Canal); and

   (b) The Meadowview area of Sacramento (south of Meadowview Road, east of the Sacramento river, and west of the Western Pacific Railroad, and of the North of the Sacramento City Corporate Boundary

2. Map of actual and potential nesting sites in the study area: and

3. Inventory of the quantity and quality of foraging habit utilized by the hawks in the study area (with map).

California Giant Garter Snake

Task 2C: Background - Based on a review of the relevant literature, the following will be provided:

1. Describe the habits, preferred habitat and status of the giant garter snake (GGS) in California;

2. Provide background information on the listing of the GGS as a threatened species in California, including:

   (a) Estimated historic population and statewide distribution;

   (b) Current estimated population and distribution; and

   (c) Probable causes of threatened condition.

Task 2D: Inventory of the Study Area - Based on input from DFG and USFWS, including field surveys where necessary, the following information will be provided:

1. Inventory of the number of GGS inhabiting the study area; and

2. Map of the actual and potential GGS habitats in the study area.

Product: The product of all elements under Task 2 will be a narrative description of the historic records and existing conditions of the two species and their habitats accompanied by suitable maps of relevant occurrences and potential habitats.

TASK 3: ANALYZE IMPACTS ON MULTIPLE SPECIES IN NORTH NATOMAS

The objectives of this task are to:

- Revise the Fish, Vegetation, and Wildlife Impacts and Mitigation Measures section for the American River Watershed Study EIS/EIR.

- Review and evaluate USFWS mitigation measures for the above section for compatibility with and incorporation into the Swainson's Hawk and GGS HCP's. Recommend feasible alternatives to USFWS mitigation measures.

Task 3A: Review Available Documentation

This subtask will involve review of all available documentation including the existing American River Watershed Feasibility Report and EIS/EIR, the Fish and Wildlife Service Habitat

Evaluation Procedure (HEP), the supporting technical appendices, and other supporting technical documentation, and all relevant comments from initial circulation of the EIS/EIR. An initial one-day site visit will also be made.

Task 3B: Review and Evaluate Revised Land Use Projections

This subtask will include attendance by EIP at up to two (2) meetings to discuss the revised land use projections for the proposed study area. It is assumed, however, that the revised projections will be developed by SAFCA, with input from EIP. As a result of this task, the aerial extent of the affected study area will be determined, and the ultimate amount of future developable acreage will be identified. Based on this analysis, the changes between what was analyzed in the initial EIS/EIR and the revised document will be clearly identified, including the additional amount of acreage and the geographic area to be affected, in relationship to existing and proposed land use practices. This will also include an analysis of current agricultural practices (based on the 1990 information in the USFWS Substantiating Report) that will be affected by the revised land use scenario.

Task 3C: Analyze Biological Impacts of New Development Patterns

Based on the projections provided in Subtask 3B, the impacts of that development on vegetation, wildlife, and threatened and endangered species will be identified. The HEP study prepared by U.S. Fish and Wildlife Service will be reviewed and extrapolated to cover the additional developed area. Habitat for the existing species to be evaluated will be the same as that studied in the previous EIS/EIR. [This will include the representative species considered in the HEP analysis and special status species recorded in the California Natural Diversity Database (CNDDB).] Field reconnaissance may be required to confirm current land use practices for new areas to be affected.

Task 3D: Review Mitigation Strategies

The Mitigation Plan proposed by U.S. Fish and Wildlife Service in the previous EIS/EIR will be reviewed and evaluated for inclusion in the revised assessment. If schedule permits, suggestions will be made for potential revisions to that mitigation plan as an alternate mitigation program to be included in the EIS/EIR. However, it will not be possible to fully develop an alternate mitigation program until the HCP is completed in the later tasks.

Task 3E: Prepare EIS/EIR Sections

Based on the analysis in the preceding subtasks, a revised section for incorporation in the EIS/EIR will be prepared. The format will follow that provided by SAFCA for preparation of the overall EIR. Following review of the administrative draft document, the document will be revised to respond to comments received. The draft section will then be prepared.

Products:

1. Land Use memorandum.
2. Revised Fish, Vegetation, and Wildlife section of EIS/EIR.
3. Revised Agricultural/Prime and Unique Farmlands section of EIS/EIR.

TASK 4: ASSESS IMPACTS AND DETERMINE MITIGATION GOALS

Once the existing conditions are established, the purpose of this task will be to evaluate potential impacts from growth induced in the study area and to identify mitigation goals of the resource agencies.

Swainson's Hawk

Task 4A: Assess Impacts - Based on input from DFG and a review of the relevant literature, the following information regarding potential growth-related impacts on the Swainson's hawks inhabiting the study area will be provided:

1. Summarize and evaluate the available data identifying the land area required for foraging by nesting pairs in the study area or in other similar habitats;

2. Describe and evaluate the DFG criteria for identifying foraging habitat which is "essential" to the continued existence of the Swainson's hawks inhabiting the study area; and

3. Describe the impacts to the existing hawks nesting in and around the study area if these hawks are deprived of foraging habitat in the study area. This analysis will include an assessment of potential growth induced by the project. EIP's analysis of growth potential from the Flood Policy EIR will be utilized to the extent feasible.

Task 4B: Mitigation Goals - Based on input from DFG, the following information regarding mitigation goals will be provided:

1. Describe the Swainson's hawk mitigation plans or similar plans which have been implemented by DFG or by other agencies in the Sacramento Valley and elsewhere in the state; also describe any other non-perching hawk mitigation plans which have been implemented elsewhere in the state or the United States;

2. Identify the existing and potential nest sites to be preserved, and the quality and type of foraging habit required to support preserved nesting habitat in the study area; and

3. Provide a map of the DFG preferred habitat conservation areas.

California Giant Garter Snake

Task 4C: Assess impacts - Based on input from DFG and USFWS and a review of the relevant literature, the DFG criteria for identifying habitat which is "essential" to the continued existence of the GGS inhabiting the study area will be described.

Task 4D: Mitigation Goals - Based on input from DFG and USFWS, the following information regarding mitigation goals will be provided:

1. Describe the GGS mitigation plans which have been implemented by DFG or by other agencies in the Sacramento Valley and elsewhere in the state;

2. Identify the type and quality of habitat required to mitigate anticipated impacts in the study area; and

3. Provide a map of the DFG preferred habitat conservation areas.

Products: Narrative description of impacts and mitigation goals, also including maps of recommended habitat conservation areas.

TASK 5: DEVELOP HABITAT CONSERVATION PLANS

With the existing conditions, impacts and mitigation goals established, the purpose of this task will be to prepare the Habitat Conservation Plans. This task will include a description of the HCP planning process, development and evaluation of alternatives, selection of a preferred HCP alternative, and preparation of the Draft HCP. The plan development process for the Swainson's Hawk is described first, followed by a similar discussion for the California Giant Garter Snake.

Swainson's Hawks

Task 5A: Characterize Planning Process - Based on input from USFWS and DFG, and independent research if necessary, the process used to develop habitat conservation plans in other parts of the state or nationwide, including the participants, the extent of public input, conservation strategies, and funding sources will be described.

Task 5B: Develop and Evaluate Alternatives - This task will describe and evaluate DFG's recommended habitat conservation plan for the Swainson's hawk, develop alternative conservation strategies, prepare preliminary cost estimates of the alternatives, briefly evaluate the environmental impacts of each alternative, and recommend a conservation strategy which meets the agreed upon mitigation goals at the lowest cost. The elements of this strategy will include, but not necessarily be limited to:

(1) Proposals for accomplishing land acquisition, including cost estimates;

(2) Long-term land management strategies, including annual operation and maintenance costs;

(3) The potential for non-local agency funding sources;

(4) Proposed monitoring and reporting methods; and

(5) Suggestions for ensuring the success of the proposed habitat conservation strategy.

A range of strategies, alternatives, and evaluation criteria will be explored in this process of developing the plan. The EIP Team would develop a range of alternatives based on an examination of a wide range of ecological, physical planning, and economic/financial issues. In developing the alternatives we will explore the following potential mitigation habitat characteristics:

Habitat Alternatives

1. Alternative Configurations of Mitigation Area

Variations in the configuration of the mitigation area could be based on a number of factors, including:

- Migration and foraging corridors;
- Proximity to development;
- Proximity to incompatible land uses (i.e. high noise zones, Bird Aircraft Strike Hazards [BASH])
- Proximity to critical life stage support zones (foraging and reproduction);
- Proximity to alternative habitat areas (nesting and foraging); and
- Results of analysis of multiple species habitat and mitigation requirements (TASK 3).

2. Alternative Sizes of Mitigation Area

Variations in the size of the mitigation area could be based on a number of factors including:

- Life history requirements;
- Predator/prey relationships;
- Confirmed home range;
- Habitat quality for food, cover, and reproduction; and
- Results of multiple species analysis (TASK 3).

3. Alternative Spatial Relationships to Other Regional Habitats

Variations in the location of the mitigation area could be based on a number of factors, including:

- Proximity to potential preservation or enhancement sites in West Sacramento, the Yolo Bypass, the Beach/Stone lakes area, the Sacramento County Draft General Plan proposed open space/wildlife refuge areas, Sutter County, and the Sutter Bypass.

Physical Planning Alternatives

1. Drainage plans in North Natomas could be integrated with the proposed mitigation area depending on the requirements for flood water retention/ detention, and based on the required locational needs associated with planned urban development.

2. Agricultural land preservation could be integrated with the proposed mitigation area depending on the potential for compatible types of agriculture and compatible agricultural practices (particularly related to use of pesticides/herbicides).

3. There exists the potential for the conjunctive use of wetlands in or adjacent to the mitigation area for the purposes of wetland habitat enhancement and for water quality enhancement. This could potentially address future NPDES requirements for non-point source urban runoff.

4. Noise incompatibilities with urban uses in the Sacramento region could be resolved, at least in part, through potential use of airspace over or near the mitigation area.

Economic Feasibility Alternatives

A wide range of financing and regulatory mechanisms will be explored in conjunction with the range of alternatives and used to "test" the viability of proposed alternatives. The mechanisms to be evaluated by the EIP Team will include, but will not be limited to, the following:

1. Developer fees;
2. Conservation easements;
3. Transferable Development Rights (TDRs);
4. "Density bonus" systems to encourage compact development;
5. Benefit assessment districts; and
6. Direct linkage programs.

Screening Evaluation of Alternatives

To evaluate the techniques and alternatives described above, screening criteria will be developed including factors such as environmental sensitivity, land use capability, economic feasibility, agency acceptance, and other criteria discussed with the Steering Committee.

Task 5C: A discussion of the recommended strategy will be facilitated among DFG, the Reclamation Board, SAFCA and Local Agencies with the aim of developing a plan satisfactory to all of the parties. The details of our approach to the facilitation process is described in Task 6.

California Giant Garter Snake

Task 5D: Characterize Planning Process - Based on input from USFWS and DFG, and independent research if necessary, the process used to develop habitat conservation plans in other parts of the state or nationwide, including the participants, the extent of public input, conservation strategies, and funding sources will be described.

Task 5E: This task will describe and evaluate DFG's recommended habitat conservation plan for the GGS, develop alternative conservation strategies, prepare preliminary cost estimates of the alternative, and recommend a conservation strategy which meets the agreed upon mitigation goals at the lowest cost. The elements of this strategy will include, but not necessarily be limited to:

1. Proposals for accomplishing land acquisition, including cost estimates.

2. Long term land management strategies, including annual operation and maintenance costs;

3. The potential for non-local agency funding sources, including the potential for federal funding should the GGS be federally listed;

4. Proposed monitoring and reporting methods; and

5. Suggestions for ensuring the success of the proposed habitat conservation strategy.

Task 5F: Develop and Evaluate Alternatives - This task will describe and evaluate DFG's recommended habitat conservation plan for the Giant Garter Snake, develop alternative conservation strategies,prepare preliminary cost estimates of the alternatives, briefly evaluate the environmental impacts of each alternative, and recommend a conservation strategy which meets the agreed upon mitigation goals at the lowest cost. The elements of this strategy will include, but not necessarily be limited to:

(1) Proposals for accomplishing land acquisition, including cost estimates;

(2) Long-term land management strategies, including annual operation and maintenance costs;

(3) The potential for non-local agency funding sources;

(4) Proposed monitoring and reporting methods; and

(5) Suggestions for ensuring the success of the proposed habitat conservation strategy.

A range of strategies, alternatives, and evaluation criteria will be explored in this process of developing the plan. The EIP Team would develop a range of alternatives based on an examination of a wide range of ecological, physical planning, and economic/financial issues. In developing the alternatives we will explore the following potential mitigation habitat characteristics:

<u>Habitat Alternatives</u>

1. Alternative Configurations of Mitigation Area

   Variations in the configuration of the mitigation area could be based on a number of factors, including:

   - Migration, foraging and upland corridors;
   - Proximity to development;
   - Proximity to incompatible land uses (i.e., roads or areas without adequate cover).
   - Proximity to critical life stage support zones (foraging, movement, reproduction, refugia);
   - Proximity to alternative habitat areas such as adjacent upland areas.
   - Results of analysis of multiple species habitat and mitigation requirements (TASK 3).

2. Alternative Sizes of Mitigation Area

   Variations in the size of the mitigation area could be based on a number of factors including:

   - Life history requirements;
   - Predator/prey relationships;
   - Confirmed home range; and

- Habitat quality for food, cover, and reproduction.
- Results of multiple species analysis (TASK 3).

3. Alternative Spatial Relationships to Other Regional Habitats

   Variations in the location of the mitigation area could be based on a number of factors, including:

   - Proximity to potential preservation or enhancement sites in West Sacramento, the Yolo Bypass, the Beach/Stone lakes area, the Sacramento County Draft General Plan proposed open space/wildlife refuge areas, Sutter County, and the Sutter Bypass.

<u>Physical Planning Alternatives</u>

1. Drainage plans in North Natomas could be integrated with the proposed mitigation area depending on the requirements for flood water retention/detention, and based on the required locational needs associated with planned urban development.

2. Agricultural land preservation could be integrated with the proposed mitigation area depending on the potential for compatible types of agriculture and compatible agricultural practices (particularly related to use of pesticides/herbicides).

3. There exists the potential for the conjunctive use of wetlands in or adjacent to the mitigation area for the purposes of wetland habitat enhancement and for water quality enhancement. This could potentially address future NPDES requirements for non-point source urban runoff.

<u>Economic Feasibility Alternatives</u>

A wide range of financing and regulatory mechanisms will be explored in conjunction with the range of alternatives and used to "test" the viability of proposed alternatives. The mechanisms to be evaluated by the EIP Team will include, but will not be limited to, the following:

1. Developer fees;
2. Conservation easements;
3. Transferable Development Rights (TDRs);
4. "Density bonus" systems to encourage compact development;
5. Benefit assessment districts; and
6. Direct linkage programs.

Screening Evaluation of Alternatives

To evaluate the techniques and alternatives described above, screening criteria will be developed including factors such as environmental sensitivity, land use capability, economic feasibility, agency acceptance, and other criteria discussed with the Steering Committee.

Task 5G: Once a recommended plan is developed, a discussion of the recommended strategy will be facilitated among DFG, USFWS, the Corps, the Reclamation Board, SAFCA and the Local Agencies with the aim of developing a plan satisfactory to all of the parties. The overall facilitation process is described in Task 6.

Products: Preliminary Draft and Draft HCPs.

TASK 6: AGENCY COORDINATION AND FACILITATION

The facilitation process will be an important element to successful acceptance and implementation of the HCPs. The process will involve interaction with the Steering Committee, Resource Agencies, and the formal consultation process required under the State Endangered Species Act. The meeting and interaction process with each of these agencies is described below.

Task 6A: Steering Committee Facilitation

EIP will convene Steering Committee meetings as needed, providing Steering Committee members with regular reports on the progress of the work, and responding to questions and guidance with respect to developing the required Habitat Conservation Plan. Comprised of the Reclamation Board, SAFCA, and the local agencies, it is expected that the Steering Committee will meet monthly to discuss issues, report on progress of the work, and provide feedback and direction on the work program. The Committee will also review and comment on work products, including the Preliminary Draft, Draft, and Final HCPs. The anticipated meeting schedule and content is as shown on the top of the following page.

Task 6B: Resources Agencies

EIP will establish and maintain contacts with the appropriate resources agencies including DFG and USFWS. USFWS has indicated that the giant garter snake may soon be federally listed. Thus, EIP will solicit USFWS input on planning for the snake and will ensure that USFWS and the Corps are appropriately involved in the consultation process. It is expected that this process will be ongoing with early input from the resources agencies on the scope of work, criteria for the HCP, and feedback on the Draft HCP.

Task 6C: Consultation Process

EIP will facilitate the consultation process required under the State Endangered Species Act. This will include periodic meetings between members of the Steering Committee and DFG, with USFWS and the Corps attending as observer/participants. The purpose of these meetings will

Phase 1:	*First Six Months*
Meeting #1:	Initiate Project, discuss schedule, work scope, and provide initial input to consultant.
Meeting #2:	Discuss results of data review, stakeholder interviews, and refine scope of work.
Meeting #3:	Review existing conditions, impacts, and mitigations.
Meeting #4:	Review impacts, mitigation goals, and proposed habitat conservation areas.
Meeting #5:	Review Preliminary Draft Plan. Review alternatives, screening results, and select Preferred Alternative.
Phase 2:	*Second Six Months*
Meeting #6:	Approve Draft Plan and discuss consultation process for meeting with agencies to gain acceptance of plan.
Meeting #7:	Discuss progress of meetings and agency consultation.
Meeting #8:	Discuss progress of meetings and agency consultation.
Meeting #9:	Review/approve Final HCP.

be to discuss impacts, mitigation goals and the elements of a habitat conservation plan for the two State-threatened species. EIP will work to facilitate a consensus plan between DFG and the Steering Committee that can be implemented at the end of the one-year study period.

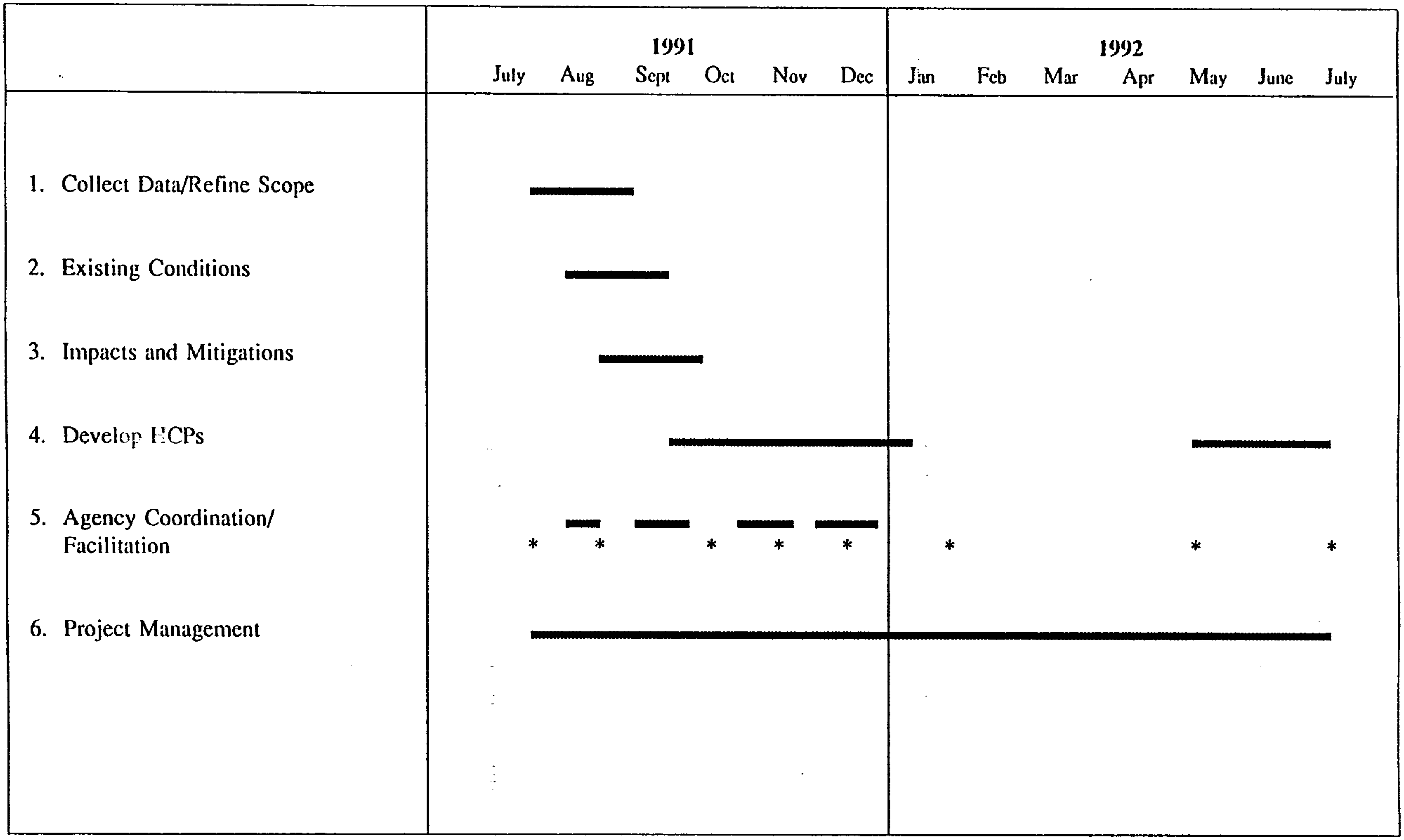
Task 6D: Private Sector Consultation

Although not included in the RFP Work Program, we believe it will be important to establish contact with certain members of the development community with land holdings in the study area. We propose that this interaction occur in the first task as part of the Stakeholder interview process and then as part of the economic evaluation of plan alternatives in Task 4. While this interaction is considered important to determine the feasibility of mitigation options and programs, it would only occur through direction from the Steering Committee.

SCHEDULE

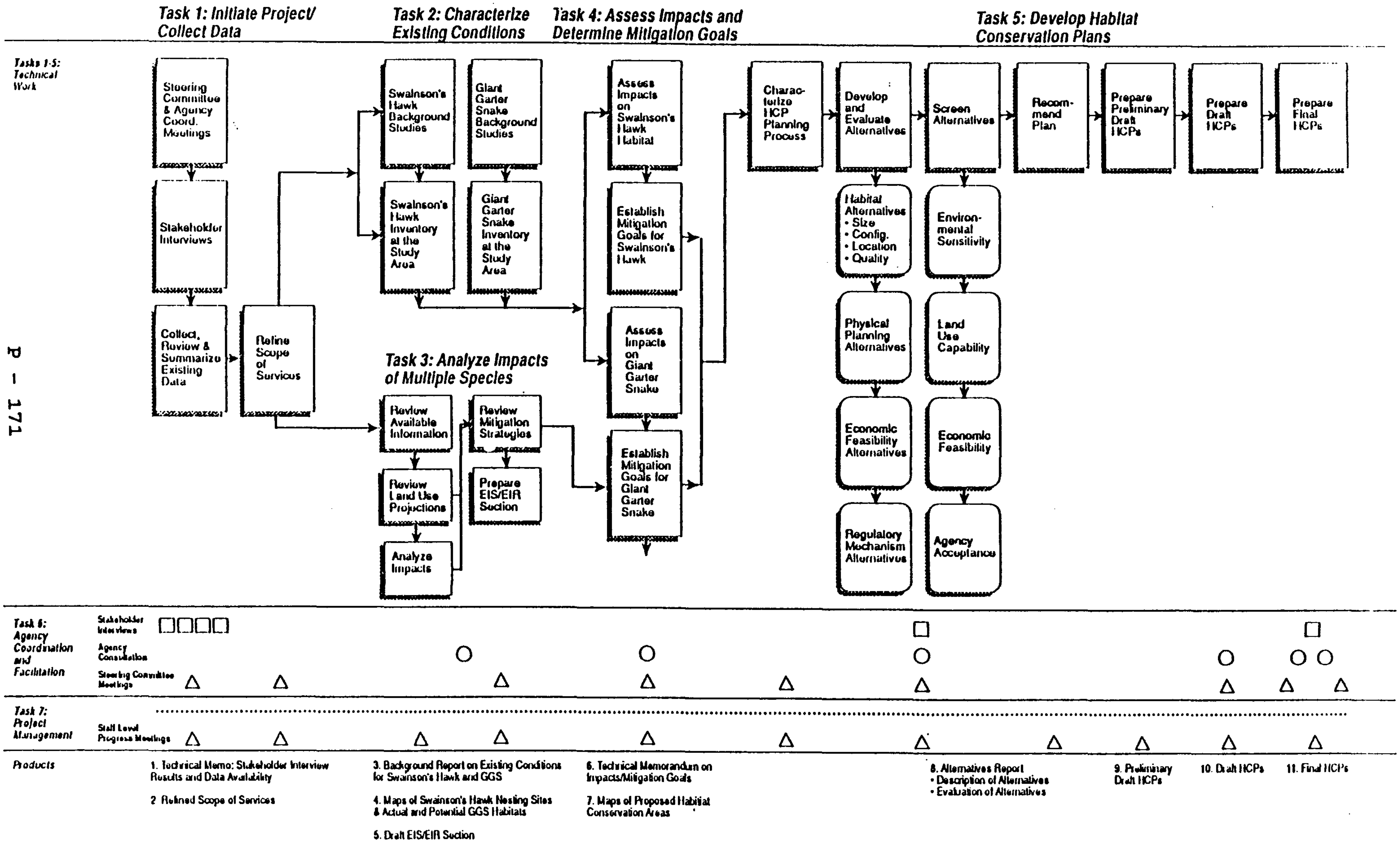
EIP's proposed schedule for completing the HCP is shown on the following page. Assuming a start-up date of mid-July, the Draft HCP would be completed by January 1992. Final plan preparation would occur by July 1992 following completion of the agency review process.

SAFCA HCP PROCESS
PROPOSED SCHEDULE



* = Steering Committee Meetings

Sacramento Area Flood Control Agency
Threatened Species Habitat Conservation Plan – Work Flow Diagram



State of California
The Resources Agency
DEPARTMENT OF FISH AND GAME

DRAFT

Status and Future Management of The Giant Garter Snake (*Thamnophis gigas*) Within the Southern American Basin, Sacramento and Sutter Counties, California

by

John M. Brode

and

George E. Hansen

Inland Fisheries Division
Endangered Species Project

August 1991

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Status and Future Management of The Giant Garter Snake (Thamnophis gigas) Within the Southern American Basin, Sacramento and Sutter Counties, California

by

DRAFT

John M. Brode[1]

and

George E. Hansen[2]

ABSTRACT

The southern American Basin, located in Sacramento and Sutter counties, provides the most important habitat remaining in California for the giant garter snake (Thamnophis gigas). Nearly 30,000 acres of farmland (including about 140 miles of giant garter snake canal habitat) and open space within the Basin may be converted to urban use over the next 50 years. Development on such a scale would probably extirpate the giant garter snake within the Basin.

This paper describes the giant garter snake habitat and the proposed developments within the Basin, and recommends measures for the preservation and future management of the snake and its habitat.

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INTRODUCTION

The giant garter snake (Thamnophis gigas) is listed by the State of California as a Threatened species (Figure 1). It is endemic to the Sacramento and San Joaquin valleys, California, where it presently occurs in a clumped distribution pattern from Butte to Fresno counties (Figure 2). It has been extirpated from the San Joaquin Valley south of Fresno County and has recently suffered serious declines in southern Sacramento County (Hansen and Brode 1980; Hansen 1982, 1986, 1988).

Fitch (1940) described the giant garter snake (GGS) as a new subspecies, Thamnophis ordinoides gigas. Since that time, the western garter snakes have undergone a number of taxonomic changes which placed the GGS as a subspecies of T. elegans (Johnson 1947, Fox 1951) and then T. couchii (Fox and Dessauer 1965, Lawson and Dessauer 1979). More recently, Rossman and Stewart (1987) proposed that the GGS be accorded full species status as Thamnophis gigas. This classification was subsequently followed by Collins (1990).

The original range of the GGS, as reported by Fitch (1940), was the floor of the Great Valley of California from Sacramento and Antioch southward to Buena Vista Lake. Fox (1951) indicated that intergrades between the GGS and a closely related subspecies, T. e. hydrophila, occurred in the Valley from Sacramento north to near Gridley, Butte County.

Hansen and Brode (1980) suggested that the intergrades reported by Fox (1951) were actually GGS, and described the range of the GGS as extending from the vicinity of Burrell, Fresno County, north through the Central Valley to the vicinity of Gridley, Butte County. Lawson and Dessauer (1979) independently included specimens from Butte County as GGS. After examination of additional specimens, Rossman and Stewart (1987) extended the range of the GGS to about 20 miles north of Gridley.

The distribution of the GGS in the Sacramento Valley coincides for the most part with the major flood basins, including the American Basin, that historically formed along the Sacramento River (Figure 3).

Before reclamation was undertaken along the river, about 60 percent of the Sacramento Valley was subject to overflow which seasonally filled the broad, shallow flood basins. These basins supported heavy growths of tules or rushes and were locally known as "tules" (Bryan 1923, Hinds 1952). Today, only remnants of these once vast "tules" remain (Figure 4).

The southern American Basin (Basin) provides the most important habitat remaining in California for the GGS. The many interconnecting irrigation canals, feeder canals and drains, especially those associated with rice farming, provide habitat and travel corridors for the snake (Hansen, unpubl. notes).

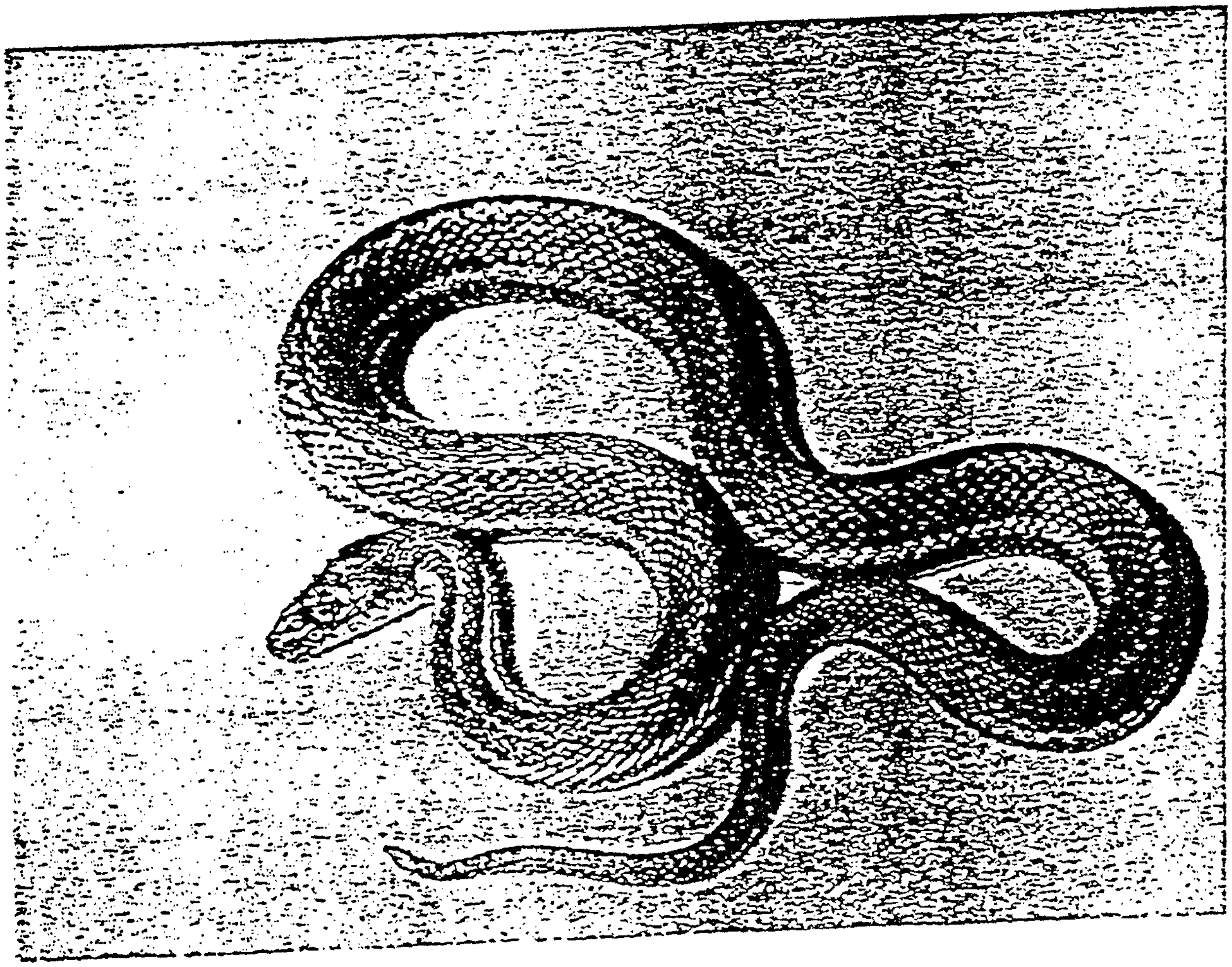

FIGURE 1. Adult female giant garter snake. Photo by George E. Hansen.

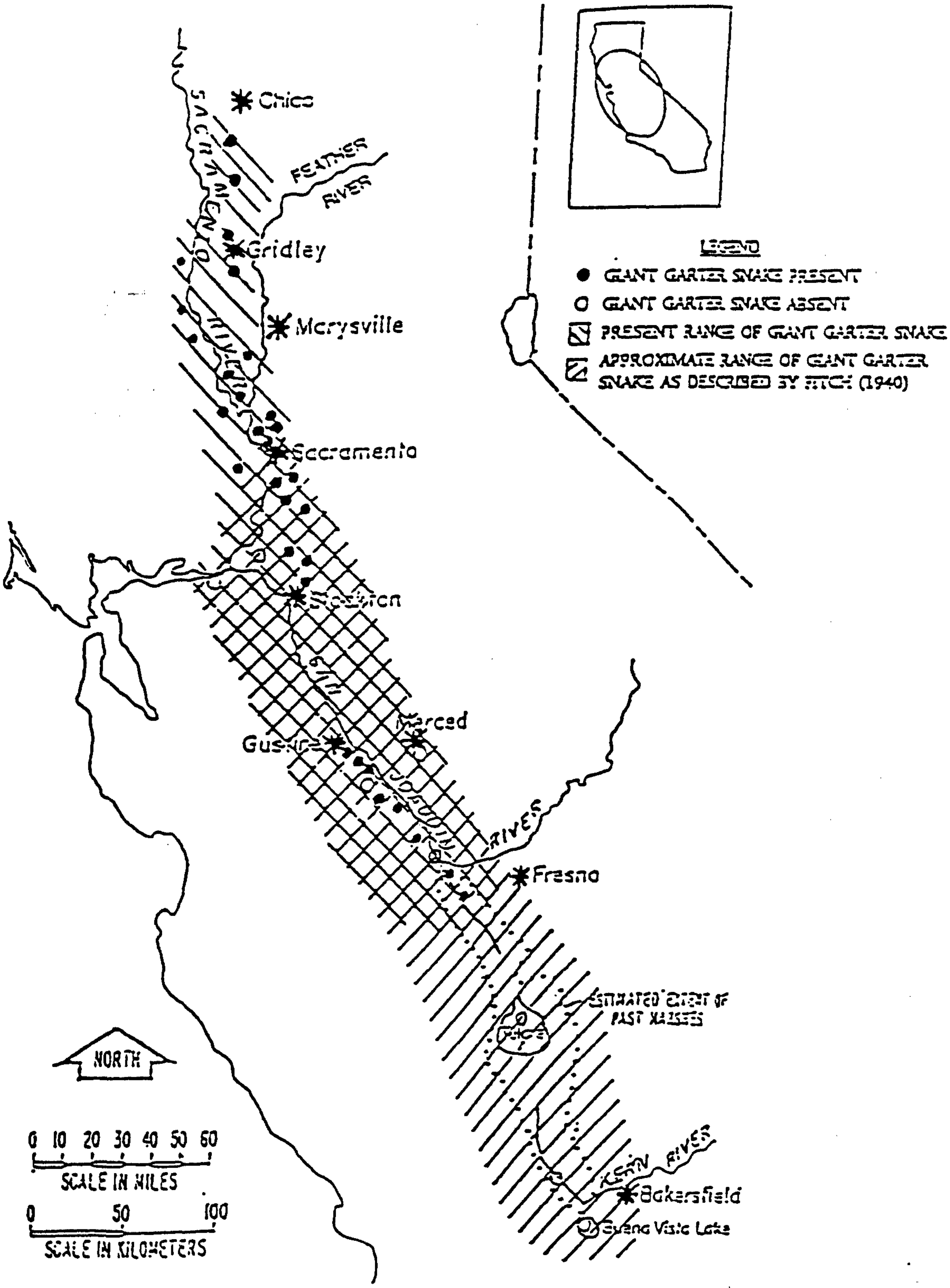

FIGURE 2. Distribution of the giant garter snake. Modified from Hansen and Brode (1980).

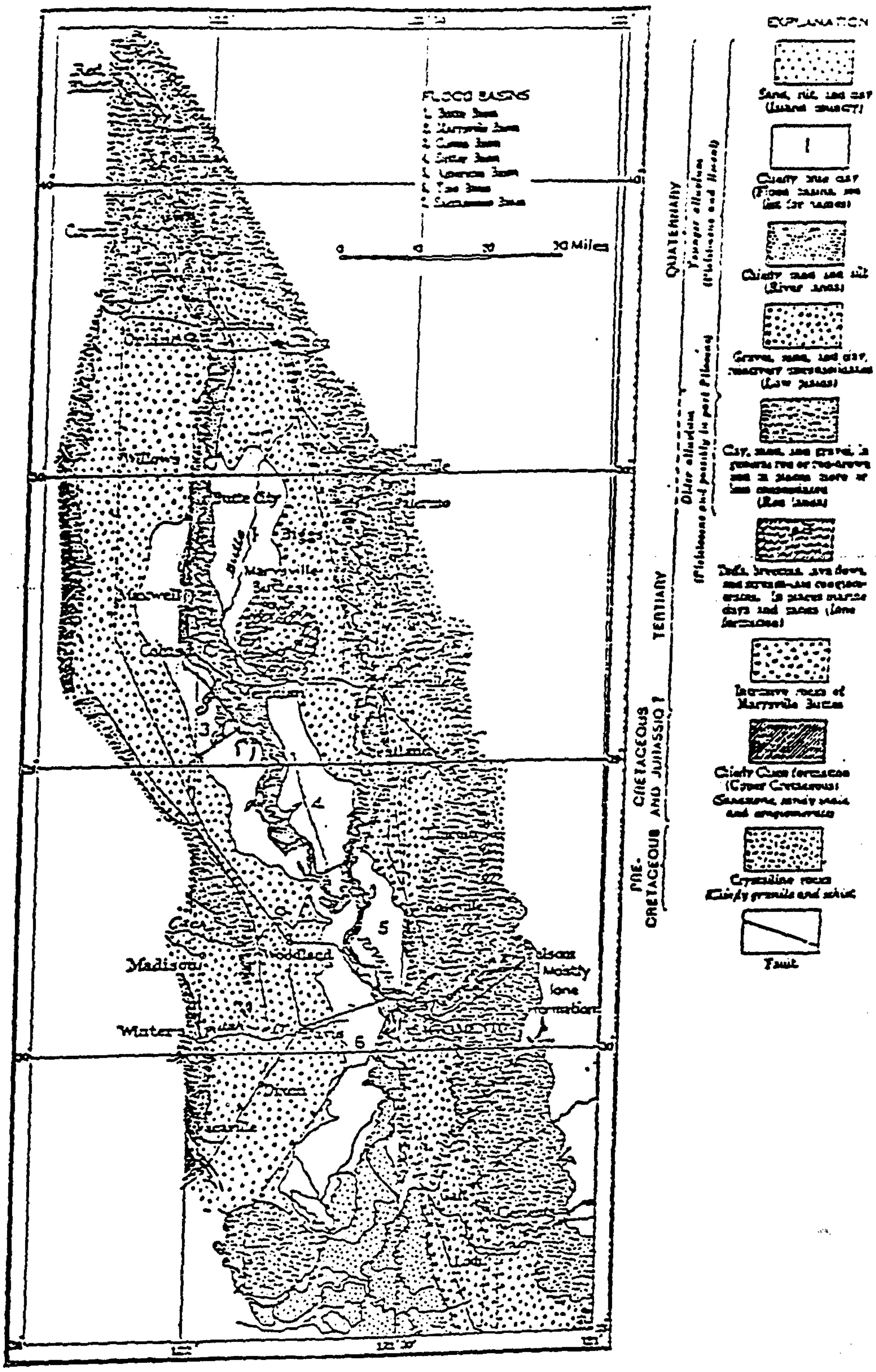

FIGURE 3. Map of the Sacramento Valley, showing geology, physiography, and locations of flood basins. From Bryan (1923).

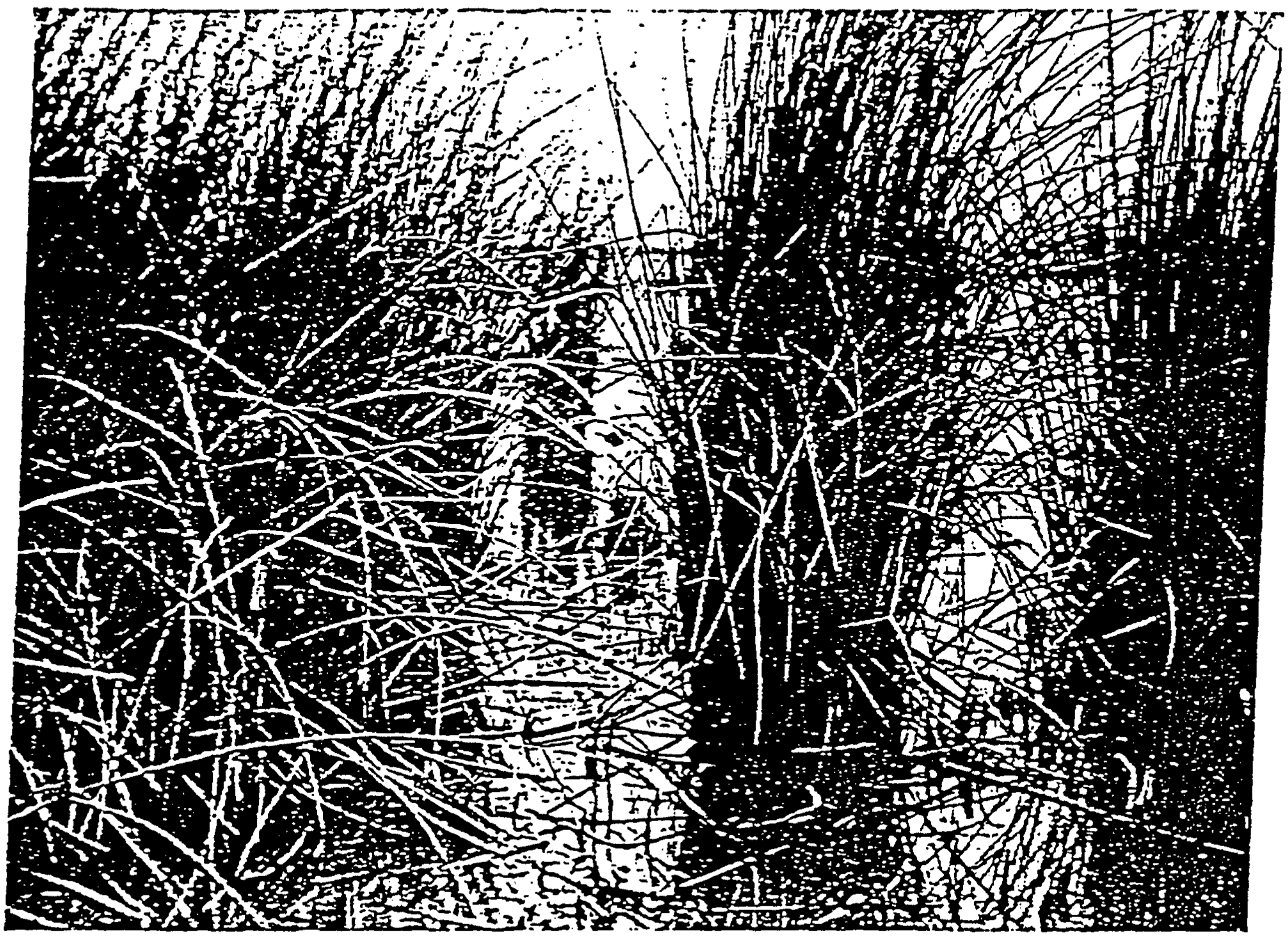

FIGURE 4. Tule marsh habitat of the giant garter snake in southern Sacramento County, California. Photo by George E. Hansen, 1977.

These irrigation canals and drains provide approximately 140 miles of GGS canal habitat. In addition, habitat is provided by small irrigation ditches and rice fields in an unknown amount.

Developments already proposed by the City of Sacramento and Sacramento and Sutter counties could adversely impact approximately 86 miles (61%) of the GGS canal habitat within the Basin. Proposed flood protection could result in the loss of nearly 30,000 acres of native habitat and farmland to urban development (U.S. Fish and Wildlife Service 1990). Approximately 25 miles of GGS canal habitat was relocated or otherwise disrupted during the widening of State Route 99/70 during 1984-1990.

The purpose of this paper is to (1) describe GGS habitat, (2) evaluate the potential impacts of the various projects on the GGS, and (3) recommend measures that will insure the continued survival of the GGS within the Basin.

STUDY AREA

The Basin lies along the eastern side of the Sacramento River north of the American River and south of the Natomas Cross Canal. The eastern and southern boundaries of the Basin are represented by the Natomas East Main Drainage Canal (Figure 5).

The Basin is characterized by agriculture, although the portion south of Interstate 80 (South Natomas) is mostly urbanized. Also the area that lies north of Interstate 80, east of Interstate 5, and south of Del Paso Road consists mostly of commercial/industrial development. The remaining major nonagricultural feature of the Basin is the Sacramento Metropolitan Airport (SMF).

Agriculture in the Basin is mostly rice farming. Irrigation water is pumped into the Basin in the spring, largely from the Sacramento River, and is routed through a series of interconnecting canals and drains. In the fall, the irrigation water is pumped out of the Basin and most of the canals and ditches remain dry, except for rain water, throughout the winter.

MATERIALS AND METHODS

Habitat within the Basin was identified in the field and delineated on U.S. Geological Survey 7.5 minute topographic maps. The linear habitat was then measured by tracing the topographic maps with a Digitizing Area-line Meter (Tamaya Planix 5000). The relative importance of various habitats to the GGS was determined by field evaluation of characteristics of the habitat and frequency of GGS sightings. Information on proposed development was gained through standard environmental review procedures.

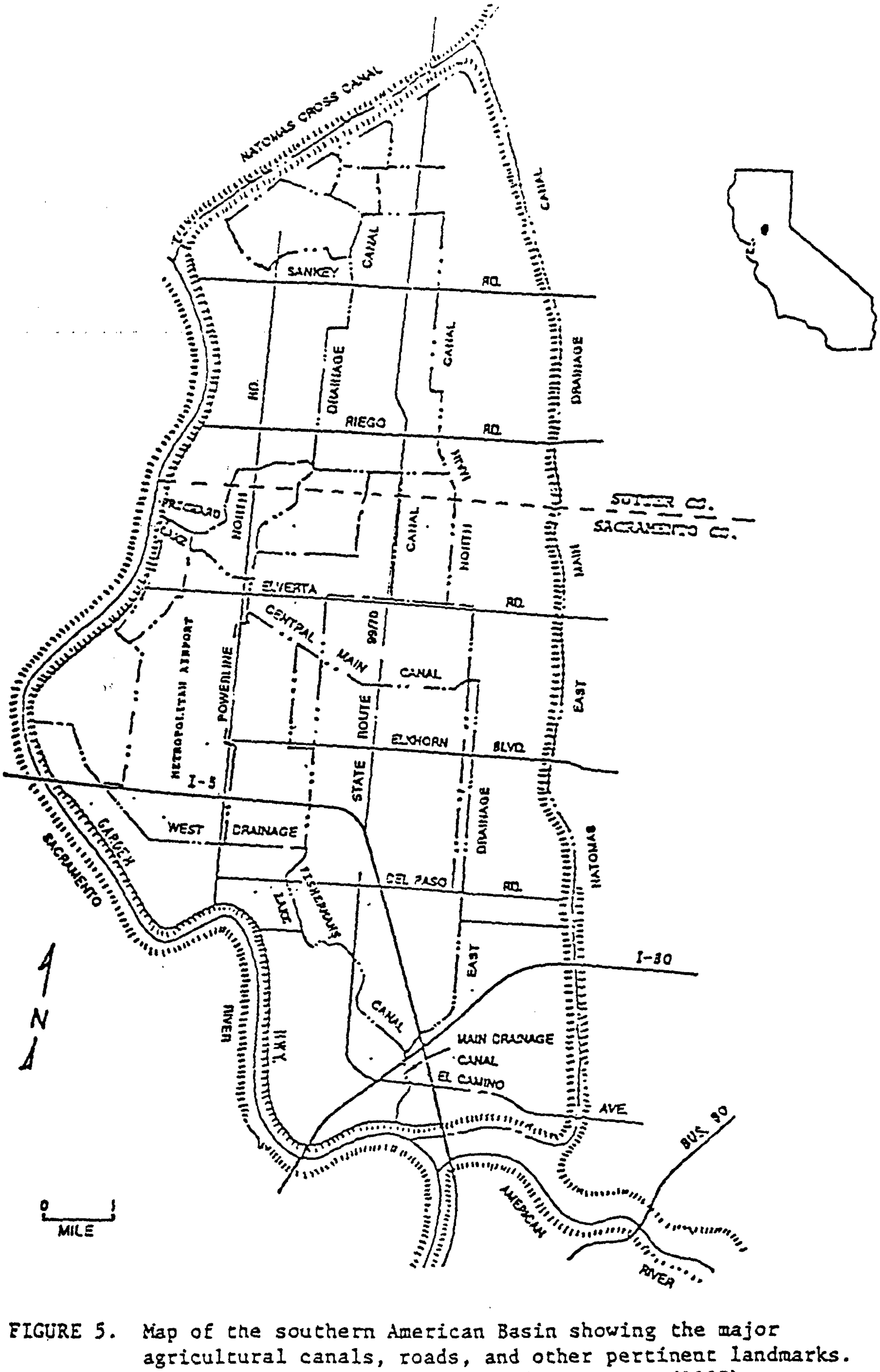

FIGURE 5. Map of the southern American Basin showing the major agricultural canals, roads, and other pertinent landmarks. Modified from U.S. Army Corps of Engineers (1987).

RESULTS

Habitat Requirements

The GGS inhabits sloughs, low gradient streams, and other waterways where it feeds on small fish and frogs. It finds shelter along banks and in adjacent uplands. It adapts well to man-made waterways as long as they have the primary requirements of (1) enough water during the active (summer) season to supply food and cover, (2) grassy banks for basking, (3) emergent vegetation for cover during the active season, and (4) high ground or uplands that provide cover and refuge from flood waters during the dormant (winter) season (Hansen 1988).

It appears that the GGS does not occur in larger bodies of water such as the Sacramento/San Joaquin Delta and the large rivers of the Sacramento Valley such as the American, Cosumnes, and Sacramento.

Habitat Within the Study Area

Although the original GGS habitat within the Basin has largely been lost, man-made irrigation canals and ditches associated with rice farming and other agriculture now provide important habitat. GGS use the canals for year-round habitat and movement between major population centers. The GGS occurs in a wide variety of canals and ditches in the area. Some are densely vegetated with little disturbance and some have a dirt road along one or both sides. Most of these waterways are ideal for the GGS because they are too small to support large predatory fish, but large enough to provide adequate food and cover.

The rice fields provide important habitat during late summer, when the fields are flooded and contain large numbers of mosquitofish (Gambusia affinis), Pacific treefrogs (Hyla regilla), and other food items. This food source may be especially important to newborn GGS (Hansen unpubl. notes).

Typical canals within the Basin are 10-20 ft wide with small levees on either side. A dirt maintenance road may be on one or both sides of the levees. The GGS appears to favor those areas where there are two or more canals or ditches in parallel combination (Figure 6). Along the canals there are periodic check dams and intersections with other canals. These structures provide habitat for the GGS in the form of deeper, food-holding water, and cover in the form of broken concrete, woody debris, and undercut banks (Figure 7).

GGS habitat within the Basin occurs in three large areas that are separated from each other by major highways (Figure 8). Within each of these three areas, movement of the GGS is generally unrestricted, except for a few short crossings over or under two-lane roads. To move between these three areas, however, GGS must

FIGURE 6. Two-ditch giant garter snake habitat along the North Main Canal adjacent to rice fields. Photo by John M. Brode, 1990.

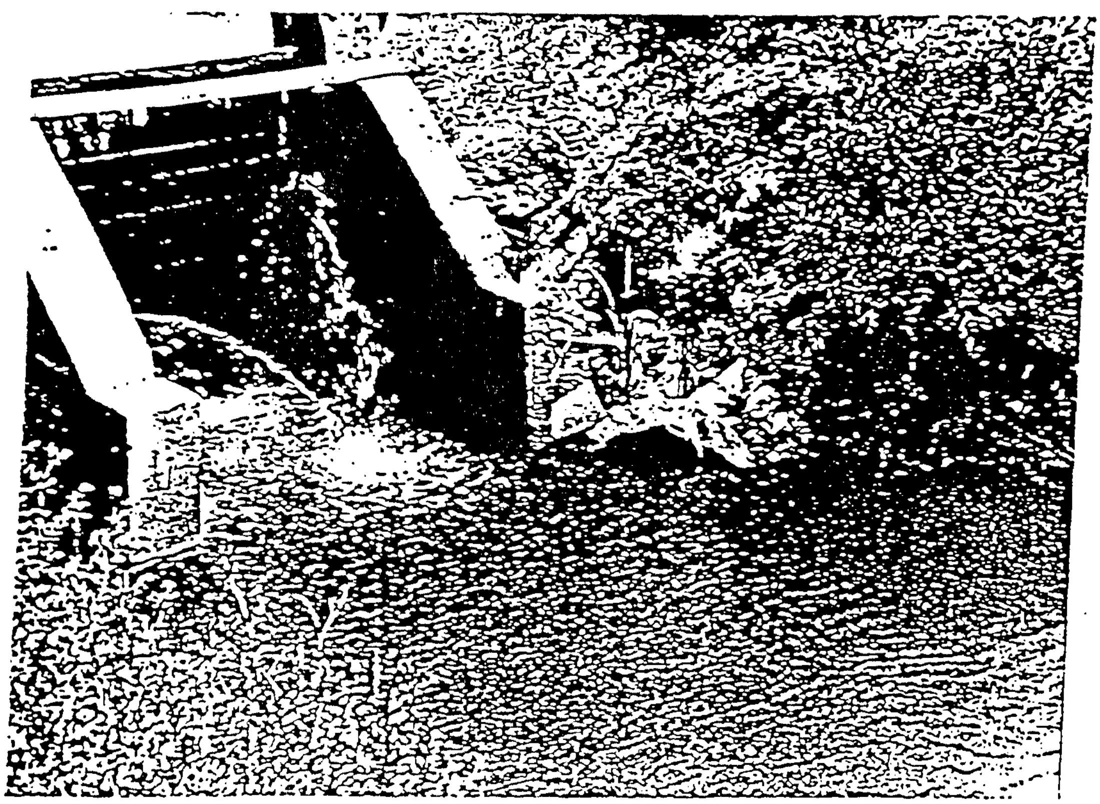

FIGURE 7. Check dam on North Main Canal. A giant garter snake was observed basking among the broken concrete on the opposite bank shortly before this photo was taken. Photo by John M. Brode, 1990.

travel over or under multi-lane highways that are 200-300 ft wide. It appears that GGS will negotiate large box culverts of considerable length, provided that vegetative cover along the canals extends to the entrance of the culverts and there is adequate clearance (2-3 ft) above the water within the culvert (Hansen unpubl. notes) (Figure 9).

Area 1. This area lies west of State Route (SR) 99/70 and north of Interstate 5 (I-5). Important habitat areas include Prichard Lake and the North Drainage Canal and its associated rice fields. Prichard Lake is a dead-end slough with steep banks and much emergent vegetation and willows (Figure 10). GGS have been observed basking in the small willows overhanging Prichard Lake (Hansen unpubl. notes). The North Drainage Canal provides good habitat and a movement corridor from Prichard Lake to the north end of Area 3. Other movement corridors for the GGS include the ditches that run south along Powerline Road and Lone Tree Road and under I-5 to the West Drainage Canal, and the East Drainage Canal that runs east and under SR99/70.

Area 2. South of Area 1 lies Area 2, which is bounded on the north and east by I-5 and on the south by I-80. Fisherman's Lake is the main habitat here (Figure 11). The West Drainage Canal flows through Fisherman's Lake and provides the main corridor for movement of GGS between areas 1 and 2. This is the smallest of the three areas and is the most isolated, having no direct connection to Area 3 except at the extreme south end where the West Drainage Canal and East Drainage Canal converge.

Area 3. The third area encompasses roughly the eastern half of the Basin. It lies east of SR99/70 and I-5 and north of I-80. The main habitat in Area 3 is located along the North Main Canal and East Drainage Canal. The North Main Canal, with its associated rice fields, is very important to the GGS (Figure 6). So important in fact, that we now refer to this canal as "Snake Alley". Snake Alley is within a prime rice-growing area, which enhances the GGS habitat. There are many connecting ditches and parallel ditches in various arrays. The combination of Snake Alley, the East Drainage Canal, and the canal that parallels the east side of SR99/70 between Elverta Road and the north end of Snake Alley provides a continuous habitat of approximately 12 miles, which surrounds about 2,400 acres of rice. There are five or six major structures associated with connecting ditches which enhance the habitat qualities of Snake Alley (Figure 7).

DEVELOPMENTS AND IMPACTS

Existing Developments

Virtually all of the Basin has been converted to agriculture. The principal crop is rice, although there are some orchards and row crops. South Natomas consists mostly of urban housing and commercial buildings. A limited amount of GGS habitat still

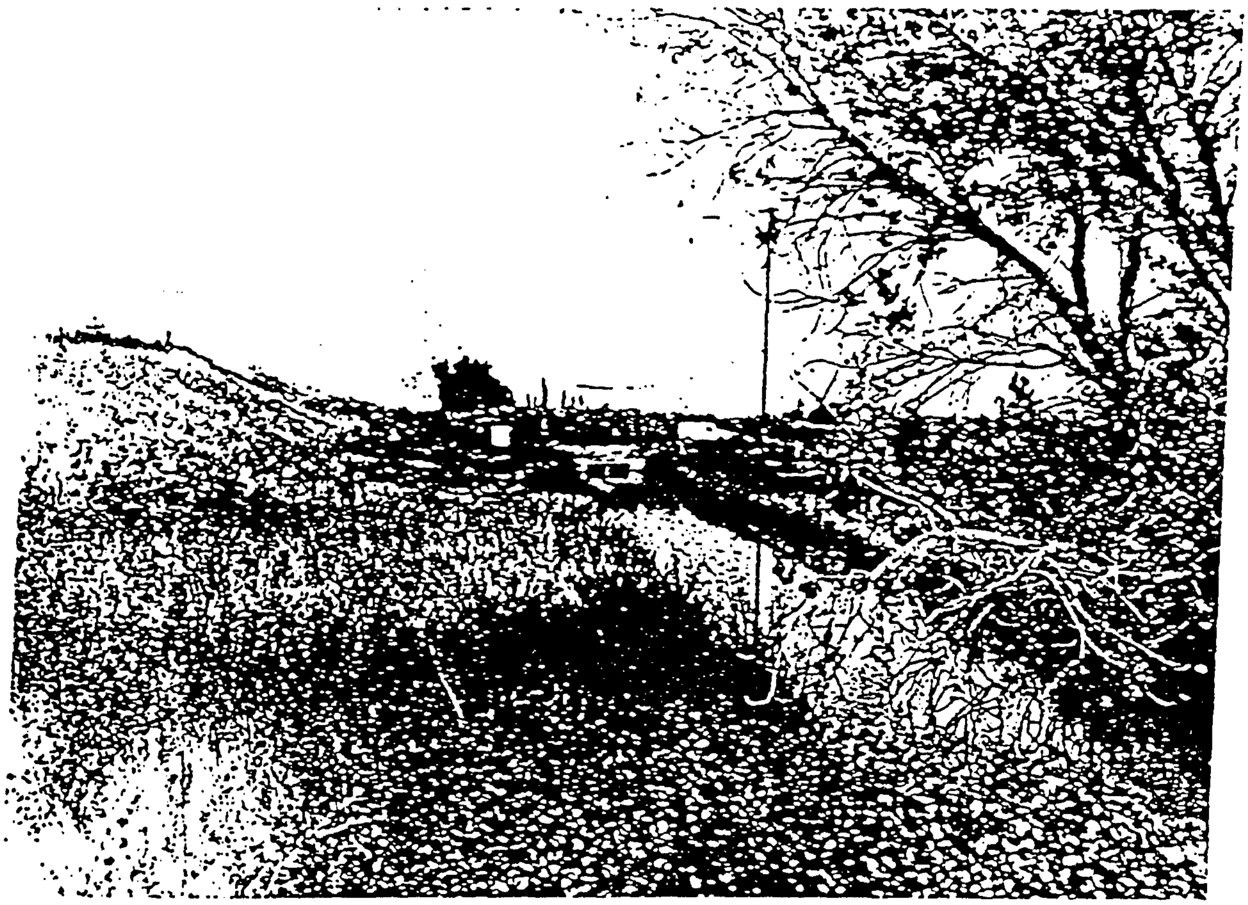

FIGURE 9. Box culvert under I-5 at Powerline Road, looking north from Bayou Road. Photo by John M. Brode, 1989.

FIGURE 10. Prichard Lake, habitat of the giant garter snake, at the southwestern terminus of the North Drainage Canal. Photo by George E. Hansen, 1987.

FIGURE 11. Fisherman's Lake, habitat of the giant garter snake along the West Drainage Canal. Photo by John M. Brode, 1989.

occurs here, along the Main Drainage Canal and associated ditches. North Natomas, south of Del Paso Road, contains light industry and two sport complexes, leaving little, if any, GGS habitat. The amount of GGS habitat lost in these two areas is unknown.

The SMF lands contain about 7 miles of actual and potential GGS canal habitat. The amount of GGS habitat lost during airport construction is unknown.

Anticipated Developments

An analysis by the U.S. Army Corps of Engineers concluded that, given a minimum of 200-year flood protection, nearly 30,000 acres of farmland and open space within the Basin could be converted to urban uses over the next 50 years (U.S. Fish and Wildlife Service 1990). If this were to take place, it could extirpate the GGS within the Basin. A number of development projects have already been proposed for the Basin. Some of them, of course, will depend upon the type and degree of flood protection that is provided in the future.

North Natomas Community Drainage System

This project is a proposal by the City of Sacramento to construct a storm drainage system to serve proposed urban development in the North Natomas area (Figure 12). The system will consist of two major open drainage channels, tributary open channels and storm drainage pipes, two pumping stations to lift storm runoff over the levee into the Sacramento River, and other related facilities. In reviewing the project, the Department determined that approximately 26 miles of GGS canal and ditch habitat would be destroyed by this project. At that time, the importance of the rice fields as GGS habitat was not fully understood, and therefore, the rice fields were not included in the estimate of habitat loss. Loss of this habitat will seriously jeopardize the continued existence of the GGS in the Basin. The project, as proposed, would not only eliminate prime habitat but may disrupt movement of the snake within the Basin. A mitigation plan to replace lost GGS habitat has been proposed by the City of Sacramento (City of Sacramento 1989). This plan, developed in cooperation with the Department, has the following objectives: 1) to replace habitat lost due to construction of the drainage system; 2) to provide, through proper design and vegetation planting, sufficient cover and refuge areas for breeding, basking, feeding and migration; 3) to provide suitable vegetation and aquatic environment for the production of GGS food items; 4) to provide a permanent water supply to sustain the mitigation habitat; and 5) to provide a viable long-term plan that will sustain the GGS population in the Basin.

The basic concept of this plan was to integrate the GGS mitigation habitat with the proposed drainage canals to facilitate maintenance and operation. The proposed mitigation habitat would consist of combinations of 1-4 parallel ditches.

If this project goes forward, the success or failure of the proposed GGS mitigation habitat will be determined through a monitoring program (City of Sacramento 1990).

Sutter Bay Proposed Development

This proposed project encompasses virtually all the land in the Basin within Sutter County (Figure 12). However, this project is only conceptual at this time and its future may well depend upon the final flood control plan that is adopted for the Basin. If it were to proceed, several thousand acres of rice and approximately 42 miles of GGS canal habitat could be eliminated or seriously depleted. Increased traffic on local roads and highways could increase GGS road kills.

South Sutter Industrial Center

This proposed project lies on both sides of SR99/70 in Sutter County between the Sacramento/Sutter County line and Riego Road (Figure 12). This project could eliminate or seriously disrupt approximately 9 miles of essential GGS canal habitat. Increased traffic on local roads and highways could increase GGS road kills.

Sacramento Metropolitan Airport and Special Planning Area

Proposed expansion of facilities within the SMF boundaries would increase road traffic, thereby potentially increasing GGS road kills. Development of the Special Planning Area (SPA), east of Powerline Road and north of I-5, would also increase traffic and, subsequently, GGS road kills. The SPA proposal is to develop about 1,920 acres of agricultural land for light industry. This project could adversely affect about 9 miles of GGS canal habitat and over 1,500 acres of rice fields. In addition to the potential habitat loss, the major north-south GGS movement corridor along Powerline Road could be disrupted (Figure 12).

Sacramento Regional Transit

The extension of light rail service to Arco Arena (North Natomas) and SMF would adversely affect GGS habitat at some of the canals. Of special concern here would be the canals along Powerline Road and adjacent to I-5 near Lone Tree Road. An alternate route could affect GGS habitat near Fisherman's Lake and the West Drainage Canal.

Highway Improvements and Construction

Any improvements to local highways and other roads will result in increased traffic and increased GGS road kills. Highway construction, especially widening of highways and roads, would destroy or seriously damage existing GGS habitat, especially where canals and ditches parallel the roadways.

DISCUSSION AND RECOMMENDATIONS

It is important to preserve the essential GGS habitat and to assure genetic heterogeneity by maintaining free movement of the GGS within and between the three major habitat areas within the Basin. GGS populations in the three areas could become isolated from one another, thereby creating subpopulations with little or no opportunity for genetic exchange.

Habitat Management

We believe that rice farming in the Basin is a key element in maintaining high populations of GGS. While the irrigation canals and drains, associated with rice farming, provide the main habitat and movement corridors, the rice fields provide additional foraging areas that may be especially important to newborn snakes (Hansen unpubl. notes). Canals and ditches in nonrice areas appear to support lower GGS numbers.

The present rice farming practices appear to be compatible with GGS. Since the fields need to dry out or, at least, be dewatered, GGS have ample opportunity to return to the canals before harvesting begins.

The present procedures for maintaining the canals and ditches are, for the most part, compatible with GGS. Certain practices, are, however, detrimental to the GGS and its habitat. The detrimental practices are: 1) spraying or otherwise removing the vegetation from the banks of the canals, 2) lining the canals with cement or gunite, and 3) excavating canals during the GGS dormant season (October 1-May 1).

Adverse impacts to the GGS during maintenance operations can be lessened by adhering to the following guidelines:

a) Excavate from only one side of the canal during a given year. Avoid excavating the banks above the high water level. Preferably, one side of the canal should be left undisturbed indefinitely (the preferred side would be the west or north side).

b) Excavate the canals during the GGS active season. This is approximately May 1 to October 1.

c) Leave the vegetation on the tops and sides of the canals undisturbed.

d) Restrict auto traffic along the canals to maintenance or other official vehicles.

Conceptual Preservation Plan

The ideal GGS habitat within the Basin, as we recognize it, consists of two or more parallel irrigation ditches, preferably adjacent to rice fields, with adequate buffering from urban areas.

Buffers between GGS habitat and urban development should extend at least 100 ft from the outside edge of the GGS habitat (levee toe or maintenance road) to a boundary fence. The buffer should consist of at least 75 ft of native or ruderal vegetation with 15-25 ft of bare ground along the boundary fence. The bare ground area could be used for a bikeway, provided that there is a fence between the bikeway and the remaining buffer zone (Figure 13). Narrower buffers would be acceptable between GGS habitat and agriculture, and the buffer width would depend upon the particular crop and farming practices. GGS habitat should be separated from roads with a minimum 30-ft buffer between the GGS habitat and the outside edge of the road right-of-way (Figure 13).

Conceptually, a preservation plan for the GGS, within the Basin, would consist of a minimum of one core habitat within each of the three main habitat areas with connecting canals to provide for movement of GGS between and within the three areas (Figure 14).

Area 1

Habitat for the GGS could be enhanced here by providing rice fields or shallow tule marshes to provide additional summer foraging habitat adjacent to Prichard Lake. The northern end of the SMF property could be enhanced to provide such habitat. The main movement corridors and canal habitat include the North Drainage Canal, East Drainage Canal, and the Powerline Road and Lone Tree Road ditches. The Powerline Road ditch could be improved to provide a more direct connection south to the West Drainage Canal. The ditches on the west side of SMF could also be enhanced to increase their suitability as GGS habitat. An agricultural preserve for rice farming, in the area bordered by Elverta Road, Powerline Road, Riego Road, and SR99/70, including the canal and ditch system, would help insure the survival of the GGS in Area 1.

Area 2

If the North Natomas Community Drainage System (NNCDS) is approved and the Del Paso Canal is built, additional GGS ditch habitat will be constructed paralleling and hydraulically connected to Fisherman's Lake on the west. If the Del Paso Canal is not built, the west side of Fisherman's Lake would still be an acceptable area for GGS mitigation habitat. Another area for potential enhancement/mitigation habitat would be south of I-5

and adjacent to the West Drainage Canal, west of Lone Tree Road. The main canal habitat/movement corridors occur along the West Drainage Canal, Powerline Road ditch, and Lone Tree Road ditch.

Area 3

This is one of the most important GGS habitat areas and is probably the most vulnerable to loss or degradation. The North Main Canal (Snake Alley) and associated rice fields support the largest known concentration of GGS within the Basin. We propose that the North Main Canal, and some of its associated rice fields, be preserved for GGS habitat.

This area would be suitable for providing a bikeway along the North Main Canal between Elverta Road and Sankey Road. Such a bikeway could be extended south to Elkhorn Boulevard along the East Drainage Canal to connect with the bikeway proposed for the NNCDS. Commercial businesses could be developed at or near the intersections of Elverta, Riego, and Sankey Roads with SR99/70, provided that rice fields remain around those areas, and the canal systems are not disrupted. The southern portion of the area encompasses the proposed NNCDS. Conceptual mitigation for the GGS has already been proposed for this area (City of Sacramento 1989). If the NNCDS is not built, mitigation for the loss or degradation of GGS habitat within North Natomas will have to be re-evaluated.

Mitigation Guidelines

The following guidelines should be followed for GGS habitat not included in preservation areas. Mitigation should be designed so that there is no net loss of GGS habitat in quantity or quality.

Relocation or replacement of GGS canal habitat does not meet the habitat quality goal for the short term. Canals supporting GGS that were relocated in 1988, during the widening of SR99/70, have not been recolonized by GGS even though vegetation and prey species (mosquitofish and Pacific treefrogs) have become established. Although GGS have been sighted regularly in undisturbed canals that connect to the relocated canals, there have been only three sightings of GGS in the relocated canals (California Department of Fish and Game 1991). It may take 3-5 years, or longer, for newly constructed canals to provide the habitat needed to support resident populations of GGS. Recruitment to the general population of GGS will be reduced because of lost habitat and the loss or displacement of adult GGS during this time.

Because newly created GGS habitat takes several years to reach maturation, replacement of existing GGS habitat requires compensation at a 2:1 or greater ratio to achieve viable GGS population levels. Compensation greater than parity is required to overcome interim population declines that occur during the time between destruction of the original habitat and maturation of the new habitat. Replacement or supplemental GGS habitat

should be constructed as soon as possible after a conservation plan is approved. The timing of these activities should follow the Department of Fish and Game guidelines (Appendix).

We are continuing studies of GGS canal recolonization in an effort to determine the time necessary for newly constructed canals to become viable GGS habitat. The success of recolonization and the time required to achieve it will be key factors in determining appropriate mitigation for the GGS.

Officials of the City of Sacramento, and Sacramento and Sutter counties should develop a coordinated long-range development plan for the Basin. The plan must provide protection and management of wildlife, especially threatened and endangered species such as the GGS.

ACKNOWLEDGEMENTS

Almo Cordone, David Showers, and David Zezulak reviewed early drafts and provided useful comments. Studies of GGS canal recolonization were funded by Caltrans.

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Appendix

Guidelines for Procedures and Timing of Activities Related to the Modification or Relocation of Giant Garter Snake Habitat[1]

Background

These procedures were developed to minimize adverse impacts to the giant garter snake (Thamnophis gigas) during construction activities in and around giant garter snake (GGS) habitat. The timing is based on present knowledge of the GGS seasonal activity cycle which may vary somewhat from year to year depending upon the weather.

GGS Activity Cycle

- o GGS begin emerging from winter retreats around April 1.
- o By April 15, most GGS are active and beginning to search for food.
- o By May 1, all GGS have usually emerged and are actively foraging.
- o Around October 1, GGS begin seeking winter retreats. Foraging and other activities are sporadic at this time and dependant upon weather conditions.
- o By November 1, Most GGS are in winter retreats and will remain there until spring.

Habitat Relocation Procedures and Timing

- o No grading, excavating, or filling may take place in or within 30 feet of existing GGS habitat between October 1 and May 1 unless authorized by the Department of Fish and Game (DFG).
- o Construction of replacement habitat may take place at any time of the year, but summer is preferred.
- o Water may be diverted as soon as the new habitat is completed, but placement of dams or other diversion structures in the existing habitat will require on-site approval by the DFG.
- o The new habitat will be revegetated as directed by DFG or as stipulated in the environmental documents.
- o Dewatering of the existing habitat may begin any time after November 1, but must begin by April 1.

[1] Prepared by John M. Brode, Department of Fish and Game, Inland Fisheries Division, October 1990.

- Any GGS surveys required by the DFG will be completed to the satisfaction of the DFG prior to dewatering.

- All water must be removed from the existing habitat by April 15, or as soon after as weather permits, and the habitat must remain dry (no standing water) for 15 consecutive days after April 15 and prior to excavating or filling the dewatered habitat.

- DFG will be notified when dewatering begins and when it is completed. DFG will inspect the area to determine when the 15-day dry period may start.

- The DFG contact for inspection will be Mr. John M. Brode (916) 355-7112, unless DFG makes other arrangements.

The above procedures are subject to revision and may be modified by DFG to accommodate special situations.

APPENDIX P
ENDANGERED SPECIES

Attachment 4

Avian Surveys Conducted in the American River Watershed Project Area
1989 and 1990

Area: Yolo Bypass, Yolo County, CA.

Location: East levee of Yolo Bypass (Tule Canal), from the small bridge (near I-5 overcrossing) to the Fremont Weir

Observer(s): MKS

Date: 5-13-89 **Time:** 1000-1400 hrs

Temp: warm **Cloud:** clear **Wind:** none

Habitat: Thin band of riparian woodland and marsh vegetation on west side of levee; orchards, rice and grain fields on east side.

Comments: Birds were observed primarily from the top of levee. Survey done on bicycle.

SPECIES OBSERVED

Pied-billed Grebe - 2
American Bittern - 1
Great Blue Heron - 5
Great Egret - common
Snowy Egret - 10
Green-backed Heron - 1
Black-crowned Night-Heron - common
White-faced Ibis - one flock of 30 flew over
Wood Duck - 2 males in canal
Mallard - common
Turkey Vulture - 1
Black-shouldered Kite - 3
Northern Harrier - 2
Swainson's Hawk - 1
Red-tailed Hawk - 3
Ring-necked Pheasant - 2
California Quail - 10
Common Moorhen - 1 in tules
Killdeer - 4
Black-necked Stilt - 3 in rice fields
American Avocet - 1 in rice fields
Rock Dove -
Mourning Dove - common
Acorn Woodpecker - 3
Nuttall's Woodpecker - 2
Northern Flicker - 4
Black Phoebe - 2
Ash-throated Flycatcher - 3
Western Kingbird - very common
Tree Swallow - common
Northern Rough-winged Swallow - 4
Cliff Swallow - common
Barn Swallow - fairly common

Scrub Jay - fairly common
Yellow-billed Magpie - common
American Crow - fairly common
Northern Mockingbird - 4
Loggerhead Shrike - 1
European Starling - fairly common
Western Tanager - 6
Black-headed Grosbeak - fairly common
Lazuli Bunting - 2
Rufous-sided Towhee - fairly common
Brown Towhee - 2
Lark Sparrow - 2
Song Sparrow -
Red-winged Blackbird - common in grain fields
Western Meadowlark - fairly common
Brewer's Blackbird - fairly common
Brown-headed Cowbird - fairly common
Northern Oriole - 1
House Finch - 10
American Goldfinch - 40
House Sparrow - 2

Area: Yolo Bypass

Location: River Road (extention of east main street of Woodland) from the west Yolo Byass levee to the Sacramento River I-5 bridge. Yolo County, CA

Observer(s): MK Sogge

Date: 6-13-89 (A) **Time:** 0700-0730 hrs

Temp: 65 F **Cloud:** clear **Wind:** calm

Habitat: Agricultural fields to the north and south. A 10-20 m wide slough runs parallel to the road, lined with tules. Very little tree canopy except at Tule Canal bridge.

Comments: Birds detected while driving slowly (with windows open) and during regular, periodic stops along road. Surveys conducted for Corps of Engineers endangered species report for the American River Watershed Project. Efforts primarily directed toward detection of Swainson's Hawks, Black-shouldered Kites, Bank Swallows, and Tricolored Blackbirds.

SPECIES OBSERVED

Great Blue Heron - 1
Green-backed Heron - 1
Black-crowned Night Heron - 3
Killdeer
Mallard
Cinnamon Teal - 2
California Quail
Mourning Dove
Western Kingbird
Tree Swallow
Cliff Swallow
Barn Swallow
Marsh Wren
Black-headed Grosbeak -2
Song Sparrow
Red-winged Blackbird
Brewer's Blackbird
Brown-headed Cowbird
House Finch
American Goldfinch
House Sparrow

Area: Yolo Bypass

Location: Elkhorn area (extension of Main Street, Woodland) near the I-5 Elkhorn exit

Observer(s): M.K. Sogge, L. Kosh

Date: 5-26-90 **Time:** 1350 -1400 hrs

Temp: **Cloud:** **Wind:**

Habitat: Small slough surrounded by emergent marsh, entire complex surrounded by agricultural fields

Comments: Birds observed during endangered species surveys for Corps of Engineers American RIver Watershed Investigation.

SPECIES OBSERVED

Killdeer - 4
Great Blue Heron - 3
Cliff Swallow - common
Marsh Wren - fairly common
Song Sparrow - common
Yellow-headed Blackbird - 3 males, 2 females; nesting
Red-winged Blackbird - common
Brewer's Blackbird - common
House Sparrow - common

Area: Auburn, upper American River, Placer County, CA.

Location: various locations along and near the North and Middle Forks of the American River, from the Foresthill bridge - 1 mi below Lake Clementine - confluence - Bureau access road to coffer dam

Observer(s): Mark Sogge, Monty Knudsen, Gary Taylor, Jane Rinck

Date: 5-3-89 **Time:** all day

Temp: warm **Cloud:** clear **Wind:** moderate

Habitat: varied. chaparral, oak/pine woodland, canyon grassland, pine forest, streamside riparian

Comments: Birds were observed incidentally to searches for HEP sample sites.

SPECIES OBSERVED

Turkey Vulture - fairly common flying above all habitats
Red-tailed Hawk -
California Quail - fairly common in chaparral and oak/pine woodland
Spotted Sandpiper - 1 along Middle Fork 1 mi upstream from confluence
Band-tailed Pigeon - 1 flew over near Lake Clementine
Mourning Dove - fairly common
Acorn Woodpecker - common in oak/pine woodland and riparian
Northern Flicker - common in oak/pine woodland and riparian
Western Flycatcher - 1 in oak/pine woodland
Western Kingbird - fairly common in grassland and open oak/pine woodland areas
Violet-green Swallow - flock of 30 near confluence
Northern Rough-winged Swallow - 4 in flock with vgsw near confluence
Cliff Swallow - abundanct near water
Scrub Jay - fairly common
Bewick's Wren - fairly common in chaparral and dense cover
Western Bluebird - fairly common
American Robin - fairly common in all woodlands
Wrentit - common in chaparral
European Starling - uncommon
Orange-crowned Warbler - 2 in woodlands
Black-headed Grosbeak - fairly common in woodland areas
Lazuli Bunting - 1 male in streamside willows 1 mile above confluence
Rufous-sided Towhee - common
Brown Towhee - 1 near hwy 49 bridge
Chipping Sparrow - uncommon
Lark Sparrow - fairly common in oak woodland
Sage Sparrow - 1 in chaparral
American Goldfinch - common

Area: Middle Fork American River, El Dorado Co., CA

Location: Middle Fork American River beginning approximately 0.5 mile above confluence with North Fork (Hwy 49 bridge), upstream about 1.5 miles.

Observer(s): M. Sogge, L. Kosh

Date: 1-19-90 **Time:** 1240-1530 hrs

Temp: 50 F **Cloud:** clear **Wind:** calm

Habitat: Steep river canyon: river channel lined with willows, open gravel bars; south facing slopes of dense chaparral; north facing slopes of mixed oak/pine woodland. Some riparian woodland along minor drainages and river banks.

Comments: This ground survey was conducted as part of the Corps of Engineers efforts to assess Bald Eagle abundance and use patterns along the upper American River. This stretch of river was chosen because of past sightings by FWS personnel. Note, however, that no Bald Eagles were seen.

SPECIES OBSERVED

Turkey Vulture - 1
Red-tailed Hawk - 2
Golden Eagle - 1 adult soaring above canyon
American Kestrel - 1
Band-tailed Pigeon - 9
Anna's Hummingbird - 1
Belted Kingfisher - 1
Acorn Woodpecker - 3
Northern Flicker - 2
Black Phoebe - 2
Scrub Jay - 5
Plain Titmouse - 1
Bewick's Wren - 3
American Dipper - 2
Ruby-crowned Kinglet - 1
Hermit Thrush - 2
Wrentit - 4
Rufous-sided Towhee - 6
Brown Towhee - 3
Song Sparrow - 1
Golden-crowned Sparrow - 2
Dark-eyed Junco - 2
American Goldfinch - 5

Area: American River Watershed Drainage, Sacramento Co, El Dorado Co., and Placer Co., CA
Location: American River (from confluence with the Sacramento upstream to North and Middle Forks near Foresthill), CA
Observer(s): Mark K. Sogge, Dave Martinez (CDPR), Leslie Lew (CDPR)
Date: 1-26-90 **Time:** Depart Sacramento Exec Airport - 0820 hrs, return 1035 hrs
Temp: 55 F **Cloud:** clear above Sacramento, partly cloudy northeast of Folsom Reservoir
Wind: calm
Habitat: Riparian/woodland and agricultural/urban corridors along the American River.
Comments: This aerial survey was part of an endangered species survey effort by the Corps of Engineers for the American River Watershed Investigation EIS and Biological Data Report. The main purpose of this flight was to search the river corridors for wintering Bald Eagles that may feed upon salmon or other fish. We flew the American River from Discovery Park upstream to an approximate elevation of1200 feet on the North Fork and Middle Fork. We also flew the perimeter of Folsom Reservoir. Altitude varied from 500-1200 feet above ground level. All sections of the river were flown twice (once in each direction). Birds listed below are those larger species which were observed from the aircraft.

NOTE: NO BALD EAGLES WERE OBSERVED DURING THIS SURVEY

SPECIES OBSERVED

LOWER AMERICAN RIVER: (to Folsom Dam; 0825-0855 and 1020-1030)

Great Blue Heron - several sightings: rookery with 12-15 nests (8-10 adults present) in large tree along south shore (residential lot) near Arden Bar; group of 25 herons flushed from trees along west shore of Lake Natoma near Willow Creek (no nests observed); rookery with about 20 nests (12-15 adults present) in tall bare deciduous tree on west bank just below (approx. 100 meters) Folsom Dam.
Great Egret - 3
Mallard - 2
Common Merganser - 3 at Nimbus Hatchery
Turkey Vulture - common along river and on gravel beds
Red-tailed Hawk - 2
Gulls (species not noted) - abundant
American Crow - common
Rock Dove

American River Watershed Drainage, Sacramento Co, El Dorado Co., and Placer Co., CA 1-26-90

UPPER AMERICAN RIVER: (Folsom Reservoir to elevation 0855-1020 hrs)

Double-crested Cormorant - 1
Canada Goose - several flocks at reservoir totaling 40-60 birds
Common Merganser - 3
Turkey Vulture - 1
Red-tailed Hawk - 1
Gulls (species not noted) - abundant
Band-tailed Pigeon - 40

Area: Folsom Lake, CA.

Location: Folsom Lake, approximately 2 miles north of Brown's Ravine.

Observer(s): MKS, Linda Kosh

Date: 5-27-89 **Time:** 1300-1800 hrs

Temp: 80 F **Cloud:** 50 % **Wind:** 10 k

Habitat: Primarily oak/pine woodland, with some grassland and small marsh areas.

Comments: Birds observed while hiking through area.

SPECIES OBSERVED

Mallard - 3
Turkey Vulure -
Black-shouldered Kite - 1
Red-shouldered Hawk - 1
Red-tailed Hawk - 2
American Kestrel - 1
Wild Turkey - 1 female along road
Killdeer - 2
Caspian Tern - 1
Mourning Dove -
Acorn Woodpecker - common
Nuttall's Woodpecker - 2
Ash-throated Flycatcher -
Violet-green Swallow - fairly common
Cliff Swallow - very common
Scrub Jay - fairly common
Bushtit - one flock of 10
Western Bluebird - fairly common, adults feeding fledged young
American Robin -
Wrentit - fairly common in heavily vegetated areas
Black-headed Grosbeak - fairly common
Rufous-sided Townee - fairly common
Chipping Sparrow - 2
Lark Sparrow - fairly common, one building nest in top of large oak
Red-winged Blackbird -
Brewer's Blackbird -
House Finch - fairly common
American Goldfinch - common

Area: American River

Location: South side at Watt Avenue Bridge, Sacramento, Sacramento Co., CA

Observer(s): M.K. Sogge

Date: 3-11-90 **Time:** 1630-1745 hrs

Temp: 60 F **Cloud:** 90 %, scatterred drizzle **Wind:** 5-8 k

Habitat: Riverine riparian strip of varying width, primarily cottonwoods, oaks, some willows. A system of backwater ponds connected to river.

Comments: Survey conducted as part of Corps of Engineers American River Watershed Investigation endangered species survey effort.

SPECIES OBSERVED

Double-crested Cormorant - 1
Wood Duck - pair in tree with nest cavity
Mallard - 8
Red-tailed Hawk - 1
American Kestrel - pair at nest cavity, male chasing flicker away
Ring-necked Pheasant - 1
California Quail -
Killdeer - 3
Greater Yellowlegs - 1
Mourning Dove - 5
Belted Kingfisher - 1
Acorn Woodpecker - 1
Nuttall's Woodpecker - 4
Downy Woodpecker - 1
Northern Flicker - 7
Black Phoebe - 2
Tree Swallow - 3
Scrub Jay - 5
American Crow - 30
Bushtit - 2
Bewick's Wren - 2
Ruby-crowned Kinglet - 4
Hermit Thrush - 2
American Robin - 15
European Starling - 37
Yellow-rumped Warbler - 8
Rufous-sided Towhee - 7
Lincoln's Sparrow - 3
Dark-eyed Junco - 3
Brewer's Blackbird - 30
Purple Finch - 1 female
House Finch - 4

Area: American River

Location: South bank, from Sunrise Ave bridge to approx. 1 mile upstream

Observer(s): M.K. Sogge, L. Kosh

Date: 4-27-90 **Time:** 1430-1645

Temp: 85 F **Cloud:** clear **Wind:** 5 k

Habitat: Riverine riparian strip bordering grass/scrub shrub river edge. Mostly gently sloping gravel/sand banks, but a few areas of 8 to 14 foot banks.

Comments: Birds observed during Corps of Engineers American River Watershed Investigation endangered species surveys.

SPECIES OBSERVED

Great Egret - 5
Green-backed Heron - 3
Wood Duck - 1 male
Mallard - common
Common Merganser - flock of 38 fishing in river: only 2 males
Turkey Vulture - common
Red-shouldered Hawk - 1
California Quail - 5
Killdeer - 5
Greater Yellowlegs - 1
Spotted Sandpiper - 3
Dunlin - 8
California Gull - 3
Forster's Tern - 3
Rock Dove - common
Mourning Dove - 2
Belted Kingfisher - 2 at nest hole
Acorn Woodpecker - 2
Nuttall's Woodpecker - 2
Northern Flicker - 1
Black Phoebe - 1
Tree Swallow - common
Northern Rough-winged Swallow - 30 to 40
Bank Swallow - nesting colony: swallows digging holes in eroded bank on southeast bank about 600-800 yards upstream of old Fair Oaks pedestrian bridge. Minimum of 15 to 20 bank swallows. NRWS also nesting here.
Cliff Swallow - fairly common
Barn Swallow - 3
Scrub Jay - common
American Crow - common
Plain Titmouse - 4
Bewick's Wren - 6
Northern Mockingbird - 2
European Starling - common
Rufous-sided Towhee - common
Brewer's Blackbird - common
House Finch - 1
American Goldfinch - 4
Goldfinch Spp. - common

Area: American River

Location: Lower American River from 200 m below Nimbus Fish Hatchery (approx. RM-22) downstream to approx. RM 21

Observer(s): MK Sogge, L. Kosh

Date: 1-13-90. **Time:** 1020 - 1215 hrs

Temp: 50 F **Cloud:** 100% cover, intermittent sprinkles **Wind:** 10 knots

Habitat: Shallow riverine aquatic bordered by riparian forest.

Comments: This ground survey was conducted as part of the Corps of Engineers efforts to assess Bald Eagle abundance and use patterns along the lower American River. This stretch of river was chosen because of its use as a salmon and steelhead spawing area, which should prove attractive to wintering Bald Eagles. Note, however, that no eagles were seen. Bald eagles are known to be disturbed by humans, and likely would be discouraged from using this stretch of river because of the high human use, particularly by fishermen who frequent the shorelines.

SPECIES OBSERVED

Pied-billed Grebe - 2
Great Blue Heron - 1
Great Egret - 1
Mallard - 3
Common Goldeneye - 9
Common Merganser - 6
Turkey Vulture - 4
Black-shouldered Kite - 1
Red-tailed Hawk - 1
California Quail - several heard calling
Killdeer - 3
Greater Yellowlegs - 1
Spotted Sandpiper - 1 foraging at shoreline
Unidentified "Peeps" - 8 foraging along shoreline
Rock Dove - 2
White-throated Swift - approx. 15 foraging over river
Anna's Hummingbird - 1
Belted Kingfisher - 1
Acorn Woodpecker - 4
Nuttall's Woodpecker - 2
Northern Flicker - 1
Black Phoebe - 2
Tree Swallow - 15 to 20 foraging over river
Scrub Jay - 5
American Crow - 4
Plain Titmouse - 6
Bushtit - one flock of 15
Bewick's Wren - 6
Ruby-crowned Kinglet - 5
Western Bluebird - 16
American Robin - 1
Northern Mockingbird - 1
Phainopepla - 1 female atop a tree
Yellow-rumped Warbler - approx. 30
Rufous-sided Towhee - 4
Golden-crowned Sparrow - 14
White-crowned Sparrow - 7
Dark-eyed Junco - one flock of 10
House Finch - one flock of 15
American Goldfinch - 1

Bald Eagle Survey Summary:

Date: 25 November 1989

Location: Along the American River, from Nimbus Hatchery downstream approximately 2 miles.

Observer: Mark K. Sogge, Environmental Resources Branch, Sacramento District COE. MKS

Time: 1000 - 1200 hrs

Weather: Clear sky, calm wind, temperature = 50 F

Comments: This section of the American River is heavily populated with spawning Chinook Salmon, and is one of the primary salmon spawining areas in the river. Live salmon were present in the shallows and riffles in large numbers, and many dead salmon were washed up on gravel bars, islands, and along the shore. Such a large concentration of accessible salmon represent a potential food source for wintering Bald Eagles.

On the above date, I surveyed for Bald Eagles along this section of the river. I traveled along the American River Parkway bike trail, stopping at all locations where I could see the river banks and adjacent trees clearly. At each stop, I scanned the shoreline, gravel bars, islands, and adjacent trees for roosting or feeding eagles.

I observed no Bald Eagles along the river. Numerous other birds were seen, including Turkey Vultures which were feeding on some of the many salmon carcasses washed up on gravel.

The abundance of perch sites in streamside trees, and the plentiful food would seem to make this an excellent area for wintering Bald Eagles. However, eagles are known to be susceptible to disturbance by humans, and often aviod areas where people congregate. The Parkway is a heavily used area, and many people walk and bike along the riverbanks to watch the salmon. It is likely that the extensive human presence along this section of the American River precludes use by Bald Eagles.

Area: Natomas Cross Canal, Sutter Co., CA

Location: Natomas Cross Canal, from Garden Hwy to within about 1 mile of Hwy 99

Observer(s): MKS

Date: 5-21-89 Time: 1500-1700

Temp: warm Cloud: clear Wind: 10-15 k

Habitat: Primarily riparian woodland and marsh vegetation along canal, rice and grain fields on east side of levee.

Comments: Birds observed from levee on east side of canal. Survey done from bicycle.

SPECIES OBSERVED

Great Blue Heron - common
Great Egret - 10
Green-backed Heron - 1
Black-crowned Night-Heron - common
Wood Duck - 1 pair in rice fields
Mallard - common
Cinnamon Teal - 1 pair in rice fields
Turkey Vulture - 1
Red-tailed Hawk - 1
American Coot - 2
Killdeer - 1
Mourning Dove - 6
Belted Kingfisher - 3
Black Phoebe - 1 nesting in pumphouse structure
Western Kingbird - 2
Tree Swallow - fairly common
Cliff Swallow - common
Barn Swallow - common
Scrub Jay - fairly common
American Crow - fairly common
American Robin - 1
Loggerhead Shrike - 2
European Starling - 1
Red-winged Blackbird - common
Western Meadowlark - 1
Brewer's Blackbird - fairly common
Brown-headed Cowbird - fairly common
House Finch - 5
Lesser Goldfinch - 2
House Sparrow - 4

Area: Natomas

Location: Fisherman's Lake, Del Paso Rd between Power Line Rd and El Centro Rd, Sacramento County, CA.

Observer(s): MK Sogge

Date: 6-13-89 (C) Time: 0800 hrs

Temp: 65 F Cloud: clear Wind: calm

Habitat: Medium sized slough bordered with tules, blackberries, and agricultural fields. Dense tree canopy for approx 200 m north of road and at least 400 m south of road.

Comments: Birds detected while walking along slough levee. Surveys conducted for Corps of Engineers endangered species report for the American River Watershed Project. Species listed were fairly common to abundant (unless otherwise noted). Efforts primarily directed toward detection of Swainson's Hawks, Black-shouldered Kites, Bank Swallows, and Tricolored Blackbirds.

SPECIES OBSERVED

Pied-billed Grebe - 1
Green Heron - 1
Common Moorhen - 2 adults, including one with young chicks
Ring-necked Pheasant - 1
California Quail
Mourning Dove
Western Kingbird
Tree Swallow
Barn Swallow
Scrub Jay
Yellow-billed Magpie
American Crow
American Robin - 2
Northern Mockingbird
European Starling - very àbundant - breeding
Blue Grosbeak - 1 first-yr male
Red-winged Blackbird
Brewer's Blackbird
Northern Oriole - 2 pairs
House Sparrow

Muskrat

Area: Natomas

Location: Natomas area from Sacramento Metropolitan Airport to confluence of Sacramento and American Rivers, Sacramento County, CA.

Observer(s): MK Sogge

Date: 6-13-89 (B)**Time:** 0730-0930 hrs

Temp: 65 F **Cloud:** clear **Wind:** calm

Habitat: Primarily agricultural fields with grains, some rice fields. Small sloughs have blackberry, scattered tules, very little tree canopy. Limited commercial development along El Camino Ave.

Comments: Birds detected while driving slowly (with windows open) and during regular, periodic stops along roads and sloughs. Surveys conducted for Corps of Engineers endangered species report for the American River Watershed Project. Species listed were fairly common to abundant (unless otherwise noted). Birds detected at Fisherman's Lake are listed separately on next page. Efforts primarily directed toward detection of Swainson's Hawks, Black-shouldered Kites, Bank Swallows, and Tricolored Blackbirds.

Route Followed: Bayou Rd at I-5 to Power Line Rd, south to Del Paso Rd, east to El Centro Rd, south to El Camino Ave, east to I-5.

SPECIES OBSERVED

Pied-billed Grebe
Common Moorhen - 1 adult with 3 young chicks in west drainage canal
Great Egret -2
Mallard
Killdeer
Black-shouldered Kite - 2
Northern Harrier - 1 female
Red-tailed Hawk - 1
American Kestrel - 4
Mourning Dove
Western Kingbird
Scrub Jay
Yellow-billed Magpie
American Crow
Northern Mockingbird
Loggerhead Shrike - 4
European Starling

Red-winged Blackbird
Western Meadowlark
Brewer's Blackbird
Brown-headed Cowbird
House Finch

Muskrat
Skunk

Area: North Natomas

Location: North Natomas area near the Sacramento Metropolitan Airport, Sacramento County, CA

Observer(s): MK Sogge

Date: 6-19-89 (A) **Time:** 0730-0915

Temp: warm (70 F) **Cloud:** clear **Wind:** 5 k

Habitat: primarily agricultural fields (grains, alfalfa, and rice fields), although the Garden Hwy is bordered on one side by the Sacramento River and associated narrow band of riparian vegetation (hwy has low density residential development). Some small canals lined with narrow band of willow and cottonwood riparian.

Comments: Birds detected while driving slowly (with windows open) and during regular, periodic stops along roads and sloughs. Surveys conducted for Corps of Engineers endangered species report for the American River Watershed Project. Species listed were fairly common to abundant (unless otherwise noted). Efforts primarily directed toward detection of Swainson's Hawks, Black-shouldered Kites, Bank Swallows, and Tricolored Blackbirds.

Route taken: I-5 frontage road from Airport exit west to Garden Hwy, north to Elverta Rd, east to Hwy 99, south to Elkhorn Blvd, west to Powerline Rd, south to Bayou Rd, east and south to Del Paso Rd, east to I-5.

There is a very large concentration of the following herons and egrets that were collecting nest material (BCNH) and roosting (possibly nesting) in the long band of very dense willow and cottonwoods along the small stream drainage that crosses Elverta Road approx 0.6 km west of Powerline Rd. Adults and fledged young of BCNH, GREG and SNEG were also foraging. This could be a significant heron rookery.

<u>SPECIES OBSERVED</u>

Great Blue Heron - 3
Green Heron - 3
Great Egret - approx 10
Snowy Egret - approx 20
Black-crowned Night-Heron - approx 50

White-faced Ibis - what appeared to be a flock of about 10 ibises flying south at a distance
Mallard
Black-shouldered Kite - 2
Northern Harrier - 4
Red-shouldered Hawk - 1 adult and 1 juv calling from trees on east side of Garden Hwy at Elkhorn Pumping Station pond (RM-73)
Swainson's Hawk - 3 soaring near junction of I-5 and Powerline Rd
Red-tailed Hawk - 3

Ring-necked Pheasant
California Quail
Killdeer
Black-necked Stilt - several scattered among the rice fields
Rock Dove
Mourning Dove
Nuttall's Woodpecker - 1
Western Kingbird
Tree Swallow
Barn Swallow
Scrub Jay
American Crow
Plain Titmouse - 1
Northern Mockingbird
European Starling
Common Yellowthroat - 1 in small patch of marsh/tules near heron rookery
Song Sparrow - 1
Red-winged Blackbird
Western Meadowlark
Brewer's Blackbird
Brown-headed Cowbird
Northern Oriole - 2
House Finch

Area: North and South Natomas

Location: Natoams area, Sacramento County, CA.

Observer(s): MK Sogge and L. Rucoba

Date: 6-19-89 (B)**Time:** 1645-1950

Temp: 85 F **Cloud:** clear **Wind:** 5-10 k

Habitat: primarily agricultural fields (grains, alfalfa, and rice fields), although some small canals and drainages are lined with narrow band of willow and cottonwood riparian. A few places along the Natomas East Main Drainage Canal have small ponds edged with cattails.

Comments: Birds detected while driving slowly (with windows open) and during regular, periodic stops along roads and sloughs. Surveys conducted for Corps of Engineers endangered species report for the American River Watershed Project. Species listed were fairly common to abundant (unless otherwise noted). The species listed below were either 1) only new species not detected during the morning survey, 2) raptors, or 3) the herons and egrets utilizing the dense willow/cottonwood riparian strip along Elverta Road 0.6 km west of Powerline Rd. Efforts primarily directed toward detection of Swainson's Hawks, Black-shouldered Kites, Bank Swallows, and Tricolored Blackbirds.

Route taken: Del Paso Rd from I-5 east to Northgate Blvd (meandering through Arena area), . north to east levee rd, north to Sankey Rd, west to Garden Hwy, south to Elverta Rd, east to Hwy 99.

SPECIES OBSERVED

Great Blue Heron - approx 10
Green Heron - 2
Great Egret - approx 30, mostly in the rice field
Snowy Egret - approx 60, about half of which were flushed from trees in the riparian band
Black-crowned Night-Heron - approx 120-140, approx half of which were flushed from the riparian band. The majority of all BCNH's seen were immatures, many were feeding in the rice field.

Pied-billed Grebe - fairly common in scattered locations in canals, also 3-5 breeding pairs in small pond in NEMDC, about 0.5 km north of Elkhorn Blvd. Adults there were feeding young chicks.
American Bittern - 1
Ruddy Duck - 1 female in NEMDC
Black-shouldered Kite - 5
American Kestrel - 1
California Quail
Common Moorhen - 5, four of which were at pond along NEMDC, approx 0.5 km north of Elkhorn Blvd. Appears to be nesting here.
American Coot

Black Tern - 1 foraging over rice field south of Riego Rd, about 1 km west of Hwy 99
Common Barn-Owl - 1 in willow/cottonwood riparian band
Marsh Wren
Loggerhead Shrike - 2

Area: Natomas / Lower American River

Location: Natomas East Main Drainage Canal south of Hwy 80, Sacramento, Sacramento Co, CA

Observer(s): M.K. Sogge, L. Rucoba

Date: 6-26-89 (A)**Time:** 0930-1130

Temp: 80 F **Cloud:** 5 % **Wind:** 5 K

Habitat: NEMDC west of Northgate Blvd is surrounded by band of dense, tall riparian vegetaion of oaks, grape and blackberry vines, willows and cottonwoods. Very good quality riparian, although narrow (30-40 m) in most areas. NEMDC east and north of Northgate bridge is much less vegetated: primarily scattered patches of willow and cottonwood riparian, with many areas bordered with thin band of tules. Levee in this region is covered with grasses.

Comments: Birds detected while driving slowly (with windows open) and during regular, periodic stops along roads and sloughs. Surveys conducted for Corps of Engineers endangered species report for the American River Watershed Project. Species listed were fairly common to abundant (unless otherwise noted). Efforts primarily directed toward detection of Swainson's Hawks, Black-shouldered Kites, Bank Swallows, and Tricolored Blackbirds.

Route taken: Garden Hwy (at I-5 overcrossing) east to Northgate Blvd, south to East Levee Rd, north to W. Silver Eagle bridge.

SPECIES OBSERVED

Great Blue Heron -1
Green-backed Heron - 2
Killdeer - 2
Black-shouldered Kite - 1 pair
Red-shouldered Hawk - 3 (including a pair perched together)
American Kestrel - 5 (including 1 nest with young)
Ring-necked Pheasant
California Quail
Mourning Dove
Anna's Hummingbird - 1 male
Belted Kingfisher - 4
Nuttall's Woodpecker - 3
Black Phoebe
Ash-throated Flycatcher - 2
Tree Swallow - 2
Cliff Swallow
Barn Swallow
Scrub Jay
Yellow-billed Magpie
American Crow

NATOMAS EAST MAIN DRAINAGE CANAL 6-26-89 (A) PAGE 2

Plain Titmouse
Bushtit
Northern Mockingbird
European Starling
Rufous-sided Towhee
Brown Towhee
House Finch

Muskrat

Area: Natomas / Lower American River

Location: Natomas East Main Drainage Canal south of Hwy 80, Sacramento, Sacramento Co, CA

Observer(s): M.K. Sogge, L. Rucoba

Date: 6-26-89 **(B)Time:** 1130-1500

Temp: 90 F **Cloud:** 5 % **Wind:** 5 K

Habitat: Garden Hwy west of I-5 is bordered on river side by band of dense, tall riparian vegetaion of oaks, grape and blackberry vines, willows and cottonwoods. Many parts are very good quality riparian, although narrow (30-40 m) in most areas. Land side of the Garden Hwy, habitat is almost exclusively agricultural croplands and orchards, with a few small sloughs that may be lined with very narrow bands of tules or blackberries.

Comments: Birds detected while driving slowly (with windows open) and during regular, periodic stops along roads and sloughs. Surveys conducted for Corps of Engineers endangered species report for the American River Watershed Project. Species listed were fairly common to abundant (unless otherwise noted). Efforts primarily directed toward detection of Swainson's Hawks, Black-shouldered Kites, Bank Swallows, and Tricolored Blackbirds.

Route taken: Garden Hwy (at I-5 overcrossing near confluence of Sacramento and American Rivers) west and north to I-5 overcrossing near the Sacrmento Metropolitan Airport, then retrace south to San Juan Rd, east to Northgate Blvd (including Orchard Rd north and south along the Natomas Main Drainage Canal).

SPECIES OBSERVED:

Green Heron - 1
Turkey Vulture
Black-shouldered Kite - 1
Northern Harrier - 1
Red-shouldered Hawk - 1 food begging call heard
Red-tailed Hawk - 4 (including one on nest shading a young downy chick)
American Kestrel - 1
Ring-necked Pheasant
Mourning Dove
Belted Kingfisher - 1
Nuttall's Woodpecker - 1
Western Kingbird
Tree Swallow
Cliff Swallow
Barn Swallow
Scrub Jay
Yellow-billed Magpie
American Crow
Plain Titmouse
American Robin

Loggerhead Shrike - 6
European Starling
Rufous-sided Towhee
Red-winged Blackbird
Brewer's Blackbird
Northern Oriole - 5 (including a female feeding fledged young)
House Finch
House Sparrow

Area: North Natomas

Location: Elverta Road, between Powerline Rd and Garden Hwy, North Natomas area north of the Sacramento Metropolitan Airport, Sacramento County, CA

Observer(s): MK Sogge, L. Kosh

Date: 7-4-89 (A) **Time:** 1130-1330

Temp: 85 F **Cloud:** clear **Wind:** 5 k

Habitat: The small drainage canal is lined with narrow band of willow and cottonwood riparian at the southern end (nearest the road). The riparian vegetation thins and disappears approximately 400m from the road, and is replaced with a wide band of blackberries and tules. The drainage is bordered and surrouned primarily by agricultural fields (grains, alfalfa, and rice fields),

Comments: Birds detected while walking along dirt road on east/north side of riparian band. Surveys conducted for Corps of Engineers endangered species report for the American River Watershed Project. Species listed were fairly common to abundant (unless otherwise noted). Efforts primarily directed toward detection of Swainson's Hawks, Black-shouldered Kites, Bank Swallows, and Tricolored Blackbirds.

There is a very large concentration of the following herons and egrets that roost (and nest) in the long band of very dense willow and cottonwoods along the small stream drainage that crosses Elverta Road approx 0.6 km west of Powerline Rd. Adults and fledged young of BCNH, GREG and SNEG were also foraging.

SPECIES OBSERVED

Black-crowned Night Heron - 150 to 200 observed
Green-backed Heron - 1
Snowy Egret - 40 to 60
Great Egret - about 30
White-faced Ibis - 2 flocks flying south, about 14 birds total
Mallard - 5 females foraging in rice field
Turkey Vulture - 2
American Kestrel - 1
Mourning Dove - 4
Western Kingbird - 5
Cliff Swallow - 10
Barn Swallow - 10
Scrub Jay - 1
American Crow - 4
Yellow-billed Magpie - 1
Loggerhead Shrike - 2
Common Yellowthroat - 10 to 12 singing males
Song Sparrow - 3 singing males
Red-winged Blackbird
Brewer's Blackbird - 3
House Finch - 2

Area: Natomas Basin

Location: Natomas Basin, Sutter and Sacramento Counties, CA

Observer(s): M.K. Sogge, L. Kosh

Date: 5-26-90 **Time:** 1100-1220

Temp: warm **Cloud:** clear **Wind:** calm
Habitat: Combination of agricultural fields (mostly), scattered strips of trees and shrubs, open water/sloughs.
Comments: Birds observed during Corps of Engineer sponsored endangered species surveys for the American River Watershed Investigation. Species noted were fairly common to abundent unless otherwise noted. This survey primarily conducted along Riego, Powerline, and Elverta Roads west of Hwy 99.

SPECIES OBSERVED

American Bittern - 1
Great Egret
Snowy Egret - fairly common in area; mixed rookery with night herons in willow thicket along Elverta Road. Minimum of 40 nests observed, some with eggs.
Green-backed Heron - 2
Black-crowned Night-Heron - common in rice fields in area; rookery in willow riparian strip along Elverta Road, just east of airport. Many herons on nests, some with eggs and young. At least 40 nests observed.
White-faced Ibis - 3 foraging in fields near heron rookery; 30 foraging in Yolo Bypass under the I-5 Yolo Causeway near the Elkhorn Exit
Mallard
Cinnamon Teal - 6
Northern Harrier - fairly common; one pair nesting in tules near heron rookery
Red-tailed Hawk
American Kestrel - 2
Ring-necked Pheasant - 2
Common Moorhen - 1
American Coot
Killdeer
Black-necked Stilt
Black Tern - 6 individuals in 3 pairs in rice field along Riego Rd 300 yards west of hwy 99. Each pair showing nesting behavior, nest building, courtship, nest defense. Another pair copulating about 400 yards west.
Western Kingbird
Tree Swallow
Cliff Swallow
Barn Swallow
Scrub Jay
Yellow-billed Magpie
American Crow
Marsh Wren - 2
European Starling
Common Yellowthroat - 5 (one male performing song flight)
Song Sparrow
Red-winged Blackbird
Brewer's Blackbird

Area: Natomas Basin

Location: North Natomas, along Hwy 99 between I-5 and the Natomas Cross Canal

Observer(s): M.K. Sogge, L. Kosh

Date: 6-9-90 **Time:** 0700-0730 hrs

Temp: 60 F **Cloud:** clear **Wind:** windy

Habitat: primarily agricultural fields (mostly rice), with some open water/sloughs

Comments: Birds observed while driving north along Hwy 99, with stops along road when groups of birds observed. Presence, rather than numbers, of most species not noted. Should not be considered a comprehensive survey of area.

SPECIES OBSERVED

Great Blue Heron
Great Egret
Snowy Egret
Black-crowned Night-Heron
White-faced Ibis - flocks foraging in rice fields at Elverta and Hwy 99
Mallard
Cinnamon Teal
Black-shouldered Kite
Northern Harrier
Swainson's Hawk
Red-tailed Hawk
American Kestrel
Ring-necked Pheasant
Common Moorhen
American Coot
Killdeer
Black-necked Stilt
Forster's Tern
Western Kingbird
Barn Swallow
Yellow-billed Magpie
American Crow
Loggerhead Shrike
European Starling
Song Sparrow
Red-winged Blackbird
Brewer's Blackbird

Area: Natomas Basin
Location: North Natomas, along Hwy 99 between I-5 and the Natomas Cross Canal
Observer(s): M.K. Sogge, L. Kosh, C. Drost
Date: 7--4-90 **Time:** 0700-0730 hrs
Temp: 70 F **Cloud:** clear **Wind:** windy
Habitat: primarily agricultural fields (mostly rice), with some open water/sloughs
Comments: Birds observed while driving north along Hwy 99, with stops along road when groups of birds observed. Presence, rather than numbers, of most species not noted. Should not be considered a comprehensive survey of area.

SPECIES OBSERVED

Great Blue Heron
Great Egret
Snowy Egret
Black-crowned Night-Heron
White-faced Ibis - flock of 50 east of Hwy 99, flock of 70 west of highway; all foraging in rice fields
Mallard
Black-shouldered Kite
Northern Harrier
American Kestrel
Killdeer
American Avocet - flock of 30 in rice fields, smaller numbers common in rice fields
Tree Swallow
Cliff Swallow
Barn Swallow
American Crow
Red-winged Blackbird
Yellow-headed Blackbird - flock of about 15
Brewer's Blackbird
Brown-headed Cowbird
House Sparrow

DRAFT

Valley Elderberry Longhorn Beetle Habitat and Distribution in the American River Watershed Study Area

INTRODUCTION

The distribution and occurrence of elderberry (*Sambucus* spp.) and elderberry habitat in the American River Watershed Investigation study area was mapped as part of the Fish and Wildlife Coordination Act field investigations. This mapping effort was undertaken to provide information on both actual distribution and potential occurrence of the valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*), (VELB), a federally listed threatened species, in the study area. The information developed from the field studies will be used by the Sacramento District, Corps of Engineers to assess the potential effects of proposed flood protection actions in the study area on the beetle and its habitat.

Host Plant Relationships

The larvae of the threatened valley elderberry longhorn beetle feed and mature within the stems of the elderberry shrub. Use of the plants by the early stages of the beetle, a wood borer, is very rarely apparent. Frequently, the only exterior evidence of the use of the shrub by the beetle is the exit hole created by the larvae prior to the pupal stage. The beetle has been found in plants with trunks possessing a diameter of 1 inch or greater.
The desert elderberry (*S. mexicana*) is the most frequently identified host plant for larvae of the beetle (Arnold 1984, Jones & Stokes, Inc. 1987). However, taxonomic confusion exists between the desert elderberry and blue elderberry (*S. caerulea*) as a consequence of extensive phenotypic variability within populations, possible nomenclatural inconsistencies, and finally, possible introgression between species. These unresolved questions become especially problematical because the study area encompasses a large segment within the Sierran foothills (the proposed Auburn Dam and reservoir lands) as well as downstream and segments of the valley floor, within a region of observed overlap between these two named elderberry species.

Discussions by Munz and Keck (1973) and Abrams (1960) identify desert elderberry as a species distributed throughout cismontane California, occurring most commonly on open flats, stream banks, valleys and canyons below 4500 feet (Sonoran life zone of Merriam). The blue elderberry is described as occurring in open places, woods, thickets and riparian canyons of the transition and Canadian life zones along the western slope of the Sierra Nevada (and beyond) up to 10,000 feet.

Although no lower limit is identified for the blue elderberry, plants corresponding to the descriptions of this species have been observed in the Auburn Dam, Natomas and lower American River regions of the flood control study area. Consequently, the specific identity of individual elderberry shrubs throughout study area becomes problematical. One additional complication is that we do not know whether these two named elderberry species

differ in their ability to support larvae of the beetle, or the extent to which factors other than host plant systematics may function to limit the distribution of the beetle. Thus, because the American River Watershed Investigation encompasses portions of the ranges of both elderberry species, the potential distribution and occurrence of all elderberry shrubs within the study area were identified as constituting useable host plants for the species.

The relationship between elderberry life history, and pattern and process in riparian systems has not been well studied and there are few empirical data relating these subjects. Elderberry is generally accepted as being closely associated with riparian systems (USFWS 1984, Jones and Stokes 1987, 1985). Likewise, there is an indicated close relationship between the persistence and/or occurrence of VELB and the availability of elderberry of various age classes and/or the availability of a variety of microhabitat conditions (Jones and Stokes 1987). These correlations strongly suggest that the long-term maintenance of VELB may be dependent upon the availability of a full range of riparian and associated upland habitat types potentially supporting elderberry bushes throughout the range of the beetle, rather than simply maximizing the number of individual elderberry bushes per se. From the perspective of the long-term maintenance of the VELB, maintaining healthy and naturally dynamic riparian systems, with commensurate diversity of microhabitat and vegetation features, appears to be the most logical and effective approach to the maintenance and recovery of this species.

METHODS

Because of the size of the study area (about 2100 square miles) and because many portions were relatively inaccessible, it was not possible to undertake a complete search of every habitat site and mapping of each elderberry plant within the entire area. Consequently, the approach taken was to identify and map areas of vegetation that had the potential for containing elderberry shrubs based on examination of representative habitats within each geographic area of the project. This necessitated the use of aerial photographs to delineate vegetation cover types over the extensive floodplain and riverine habitats of the study area. A rating system was then developed and used to map elderberry occurrence potential rather than simply elderberry occurrence. We believe this approach is appropriate because of the observed interrelationship between elderberry occurrence and the dynamic pattern and process features of riparian systems and adjoining floodplains.

During field reconnaissance at each site where elderberries occurred, each elderberry stand and supporting habitat was noted as being one of three frequency classes: Class 1-- elderberry bushes common to abundant, with clumps typically >5 to >10 per acre; Class 2-- bushes infrequent to common, typically ranging from >1 to 5 or occasionally more per acre; and Class 3-- bushes rare or infrequent, often isolated occurrences, or widely scattered single bushes or clumps, typically $\leq$1 per acre. This rating system, in conjunction with actual elderberry sightings, available reports of other elderberry surveys, and aerial photographs were used as the basis for mapping potential elderberry occurrence for the entire study area. Thus, for each cover type in which elderberry typically is found, an expected occurrence/frequency rating was

projected for the Natomas, lower American River, and Auburn units of the American River Watershed Investigation study area. The resultant maps indicate, for a given area, a rating of the occurrence or potential for the occurrence of elderberry bushes. Each rating further indicates the frequency or density of bushes likely to occur or potentially occurring at each site based on existing habitat conditions.

RESULTS

Maps of potential valley elderberry longhorn beetle habitat are presented for the Natomas, lower American River, and Auburn areas (attachments). Maps for the Natomas area include 22 sheets: one large scale map showing the entire Natomas region (sheet NAT 1), three sheets along the Natomas Cross Canal (sheets NCC 1-3), nine sheets along the Sacramento River (sheets SAC 1-9) from the Fremont Weir area to the confluence with the American River, and eight sheets along the Natomas East Main Drain (sheets NEMD 1-8). The lower American River from the confluence with the Sacramento River to Nimbus Dam comprises ten maps (LAM 1-10). Auburn area maps include 8 sheets (Auburn 1-8).

Sacramento River and Lower American River

Occurrence of elderberry along the Sacramento and lower American Rivers was patchy with some sites showing very high densities of bushes and others of comparable habitat conditions having none. Levee slopes and open grasslands, which are mainly vegetated by grasses and annual forbs, consistently supported scattered bushes of varying ages, but these typically occurred as highly dispersed individuals or isolated clumps. Most levee slopes showed evidence of intense maintenance such as burning or mowing, thus many of the bushes were stump sprouts.

Along most of the Sacramento and lower American Rivers (on both sides), the levees were often rated and mapped as low potential and low frequency elderberry habitat. At a few sites, bush densities were very high such as near the outlet to the Natomas Cross Canal. These sites were most often indicative of higher diversity sites where a variety of shrubs and very young trees appeared to be present, but conditions still were dominated by the herbaceous layers.

Levees, although artificial, inadvertently provide habitat conditions comparable to the former higher terraces and upland habitats of natural riparian systems that typically supported a mosaic of savanna and grassland habitat.

Riparian forest habitats along the Sacramento and lower American Rivers varied considerably in conditions for elderberry. Most sites of low terrace early cottonwood forest and sandbar willow scrub showed low occurrence of elderberry and hence were commonly mapped as low potential/low frequency. Sites of mixed riparian forest, where the habitat was composed of dense, mixed stands dominated by oak, ash and other higher terrace trees, and older subdominant cottonwood, commonly had elderberry shrubs in moderate numbers. Consequently, sites of comparable conditions were mapped as the moderate potential class.

Sites dominated by more open stands of oaks, ash, sycamore, higher terrace willows, and diverse shrub component, however, showed much greater elderberry frequency of occurrence or potential, and thus, were rated and mapped as the highest potential sites. Other high occurrence and high potential sites included levees and open areas of higher elevation scrub-shrub habitat with moderate to high diversity of shrub and tree species.

Natomas Cross Canal and East Main Drain

The Natomas Cross Canal and Natomas East Main Drain are largely of low potential for elderberry apparently because of the typically long inundation periods and flooding along these artificial waterways, and also perhaps because of intense human disturbances (vegetation clearing and burning, and trampling by vehicles and people), especially along the Natomas East Main Drain. The lower end of the drain along the American River Parkway has the highest potential and frequency of occurrence of elderberry, the highest vegetation diversity and the highest availability of suitable habitat types along the Natomas East Main Drain. From the confluence with the American River to the Arcade Creek confluence, all three classes of suitable habitat exist. In this area moderate- and low-rated habitats occur in approximately equal amounts. Higher rated habitat occurs mainly near the Northgate triangle. The confluence of Dry Creek represents a more localized area along the drain supporting all three classes of elderberry habitat.

Conditions along the Natomas Cross Canal from near the Sacramento River confluence at Verona to the junction with the Natomas East Main Drain near the town of Pleasant Grove include mainly grass covered levees and side slopes, and the main drainage channel with mainly low terrace willow shrub, herbaceous emergent vegetation, and periodic occurrences of higher terrace oaks and upland shrubs. The woody channel vegetation is periodically cleared in an apparent effort to improve flow through the channel to the Sacramento River. Consequently, the Natomas Cross Canal supports an approximately equal mix of moderate- and low-rated elderberry habitat.

The remainder of the Natomas East Main Drain, from the juncture with the Natomas Cross Canal to the Arcade Creek confluence, consists of low terrace willow and emergent vegetation. Open areas along levee crowns and channel sides support mainly grasses and many barren sites with highly compacted soils. The levees and side slopes are periodically mowed or burned. Several of the more open grass-covered flats of the low terrace channel bottom are popular access sites for people and vehicles, and thus, are heavily trampled or compacted. Since elderberry is rarely present along these reaches, the suitability rating is low. However, with appropriate management (fencing, control of public use and vehicle entry), and establishment of more natural and consistent flow conditions, habitat suitability for elderberry and other riparian species could be greatly improved.

Dry and Arcade Creeks were not mapped.

Natomas Interior

The interior portions of Natomas, as presently managed, provide little suitable elderberry habitat as a consequence of intensive agricultural activities. However, a number of sites, mainly along drainageways, canals, ditches, and a few natural channels provide suitable conditions for elderberry. These are indicated on map NAT 2. Most of the sites in the Natomas interior are of low rating because most consisted of dense willow, mainly low terrace habitats. Bannon Slough and the lower segment of the Natomas Drainage Canal provided the only areas of moderate rating.

Auburn Area North and Middle Forks

Elderberry bushes were observed at the upper most extent of the north and middle forks of the American River. Like the lowland areas, bushes were most frequently present on the higher elevation portions of the alluvial terraces and sand bars along the river bottoms. However, side drainages and tributaries frequently harbored isolated occurrences of elderberry bushes. As a consequence, the majority of the habitat along these forks within the anticipated inundation areas is of low rating. High-rated sites consist mainly of the alluvial terraces with scrub shrub vegetation, and those rated moderate consist of higher grassland and woodland and oak forest vegetations.

DISCUSSION

The attached elderberry maps displaying distribution and potential occurrence can be used to prepare an environmental assessment that evaluates the likely impacts to these habitats with implementation of a flood control project. Since most of the maps are drawn to scale, it is possible to calculate the acreage of each category of potential elderberry occurrence and indicate the extent (in acres), of likely impacts to valley elderberry longhorn beetle habitat. In evaluating the likely effects of a given action, special attention should be given to potential changes in flow conditions, inundation times, or erosion sedimentation rates, since these riverine processes appear to have a direct affect on the persistence of elderberry at a given site and the potential for a site to support the plant over time. Although site specific losses from construction activities are most easily identified, changes to the riparian system processes of flow dynamics and volumes, sedimentation, erosion, and deposition are more pervasive and have th potential to cause more extensive effects on the adjoining riparian habitats.

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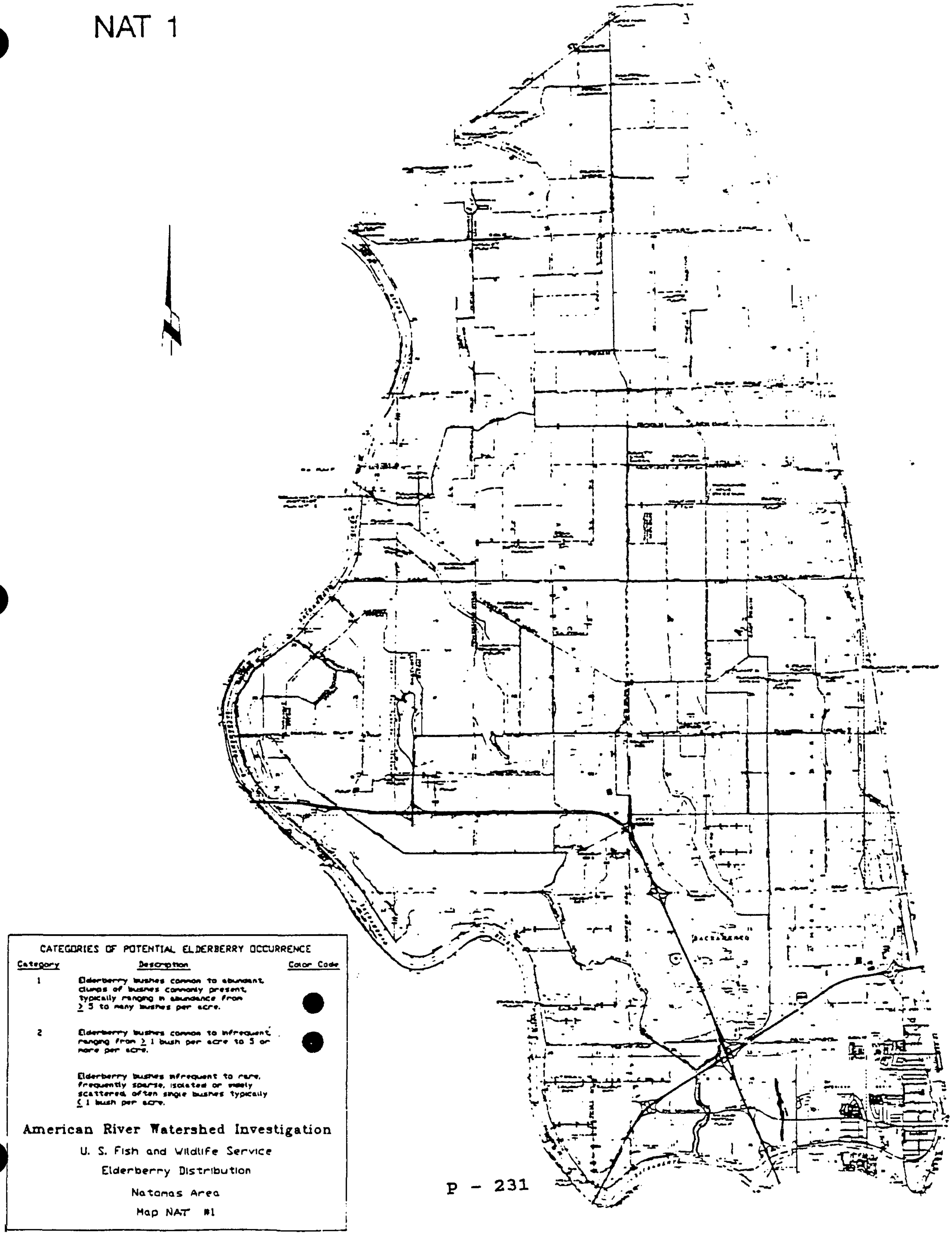
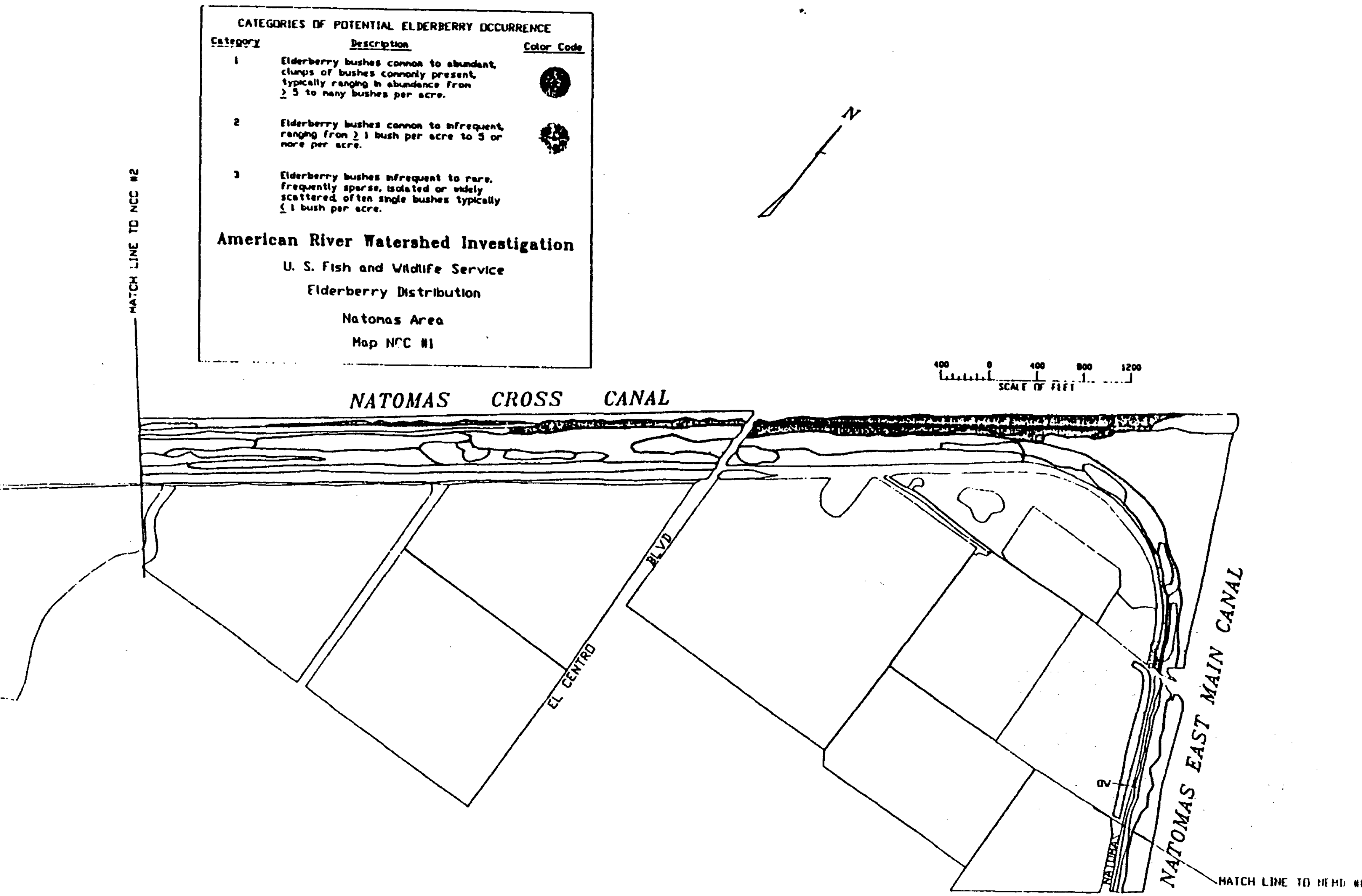
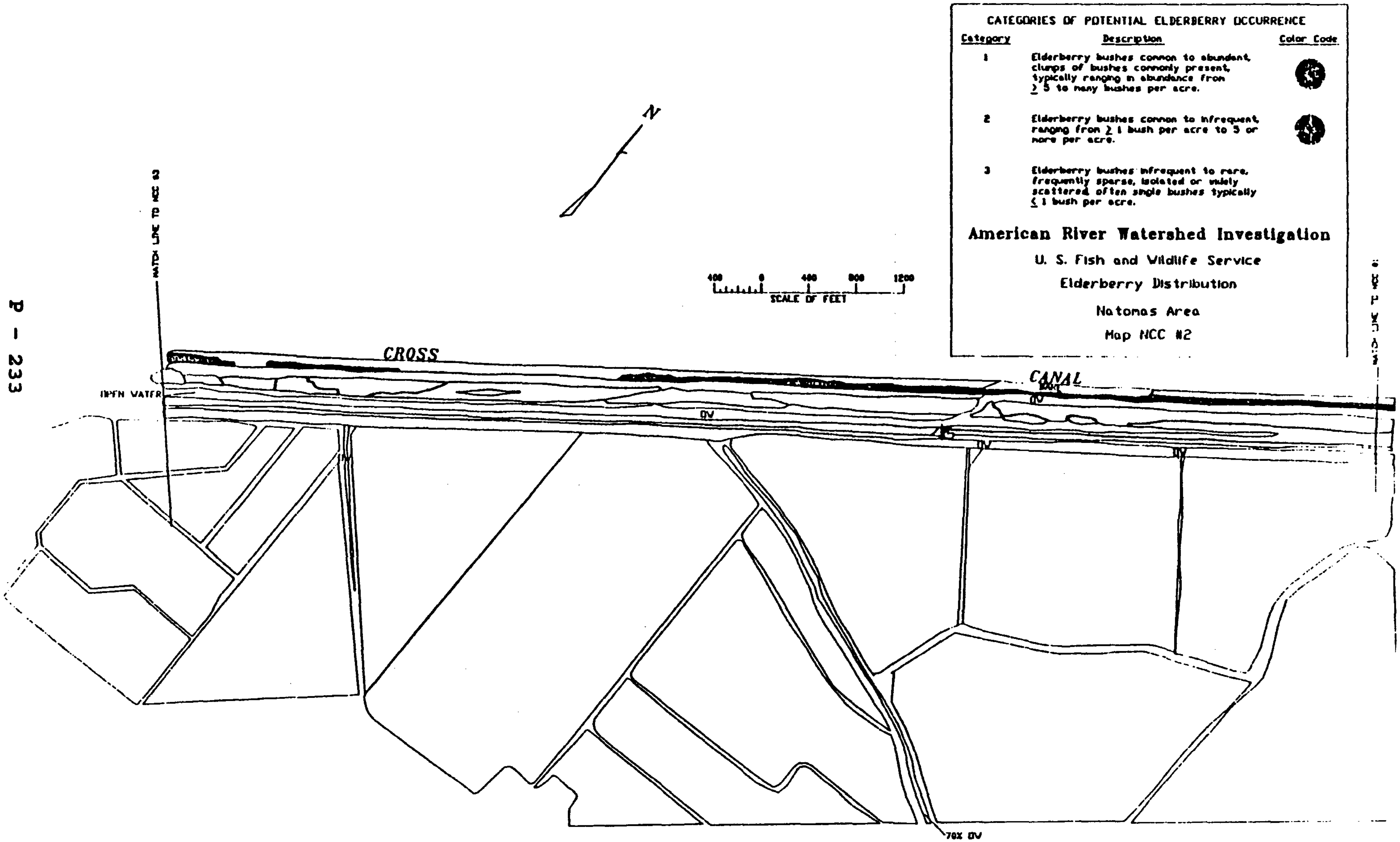
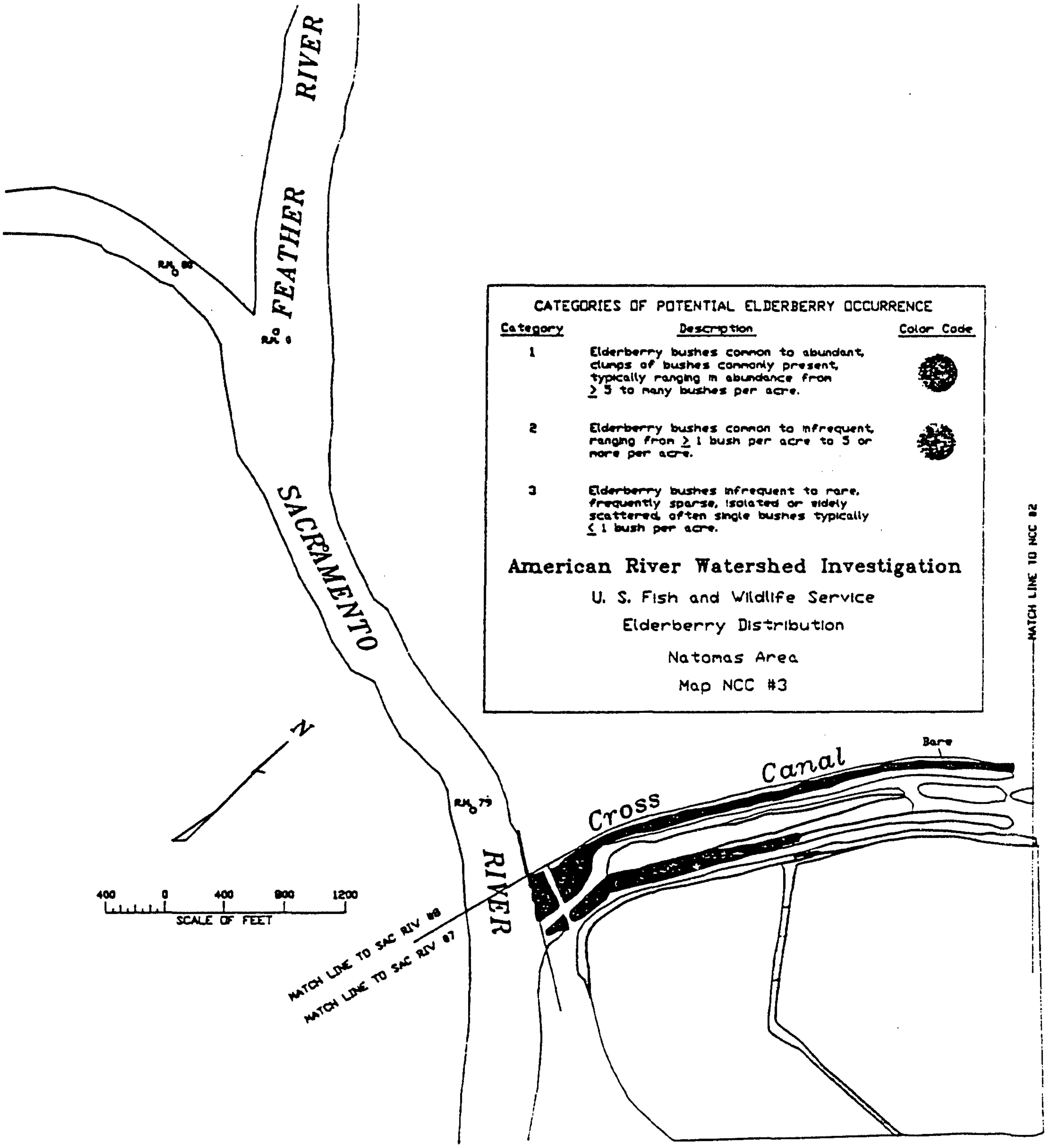
NATOMAS INTERIOR

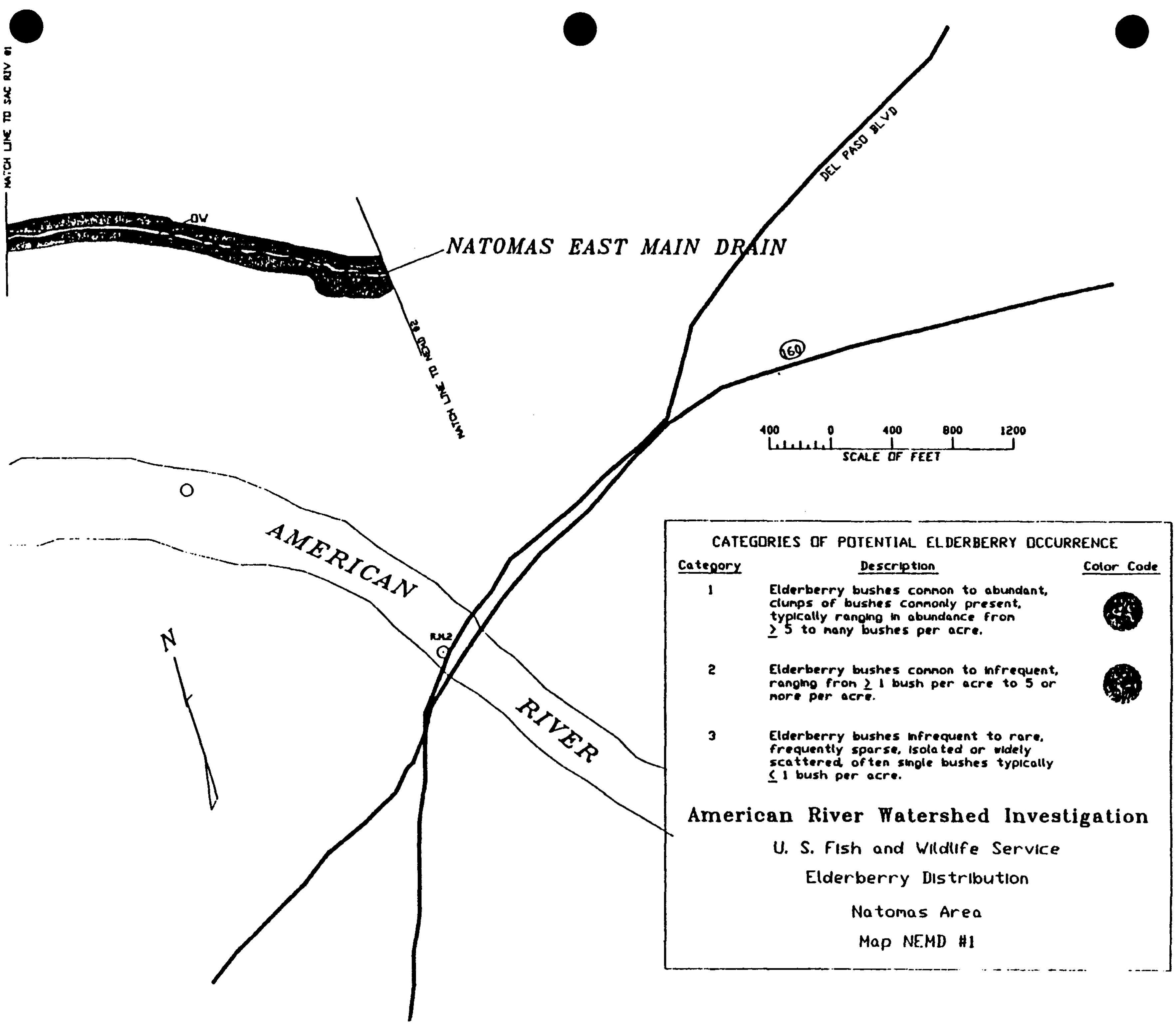
NAT 1

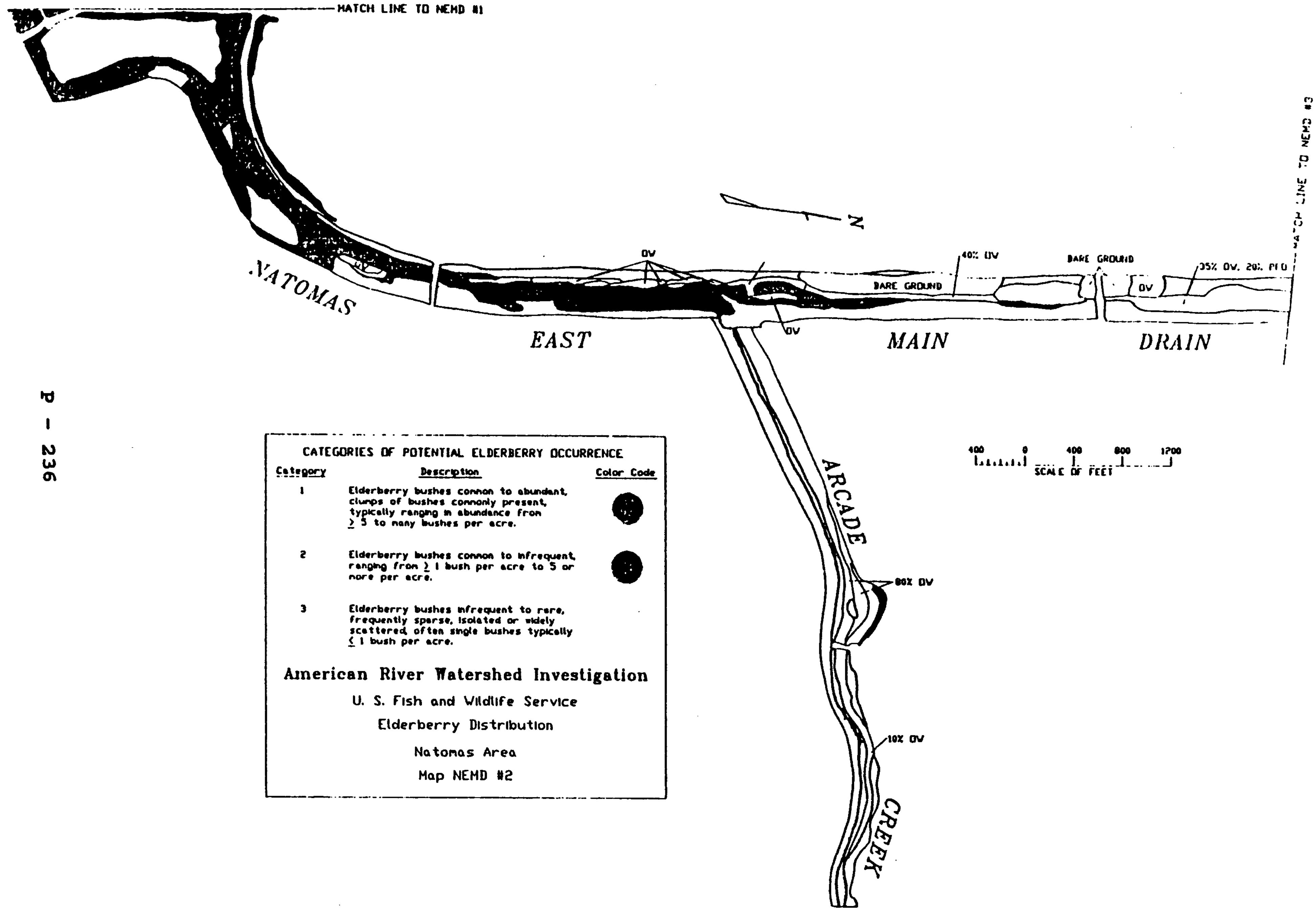


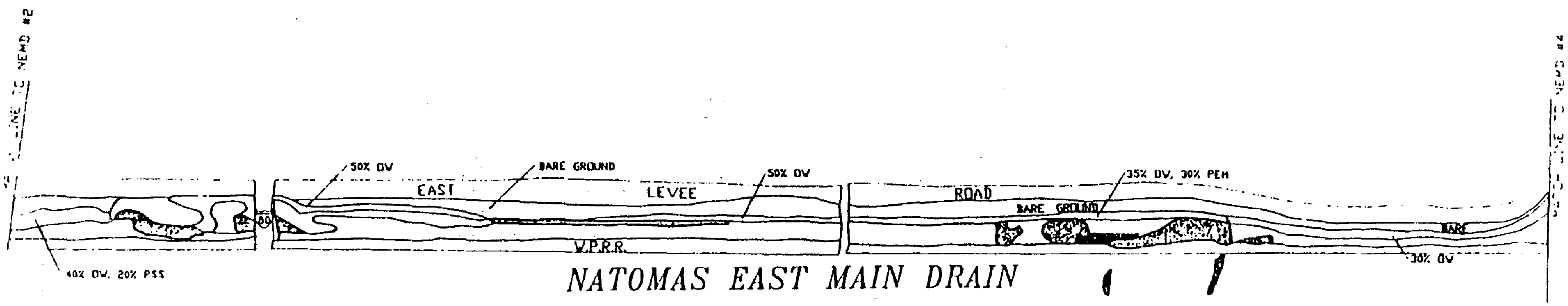

CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE
Category
Description
Color Code
1
Elderberry bushes common to abundant, clumps of bushes commonly present, typically ranging in abundance from ≥ 5 to many bushes per acre.
2
Elderberry bushes common to infrequent, ranging from ≥ 1 bush per acre to 5 or more per acre.
3
Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered, often single bushes typically ≤ 1 bush per acre.
American River Watershed Investigation
U. S. Fish and Wildlife Service
Elderberry Distribution
Natomas Area
Map NCC #1
N
MATCH LINE TO NCC #2
NATOMAS CROSS CANAL
400
0
400
800
1200
SCALE OF FEET
EL CENTRO BLVD
NATOMAS EAST MAIN CANAL
OV
NATOMA
MATCH LINE TO NEMD #8

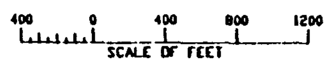

CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE
Category
Description
Color Code
1
Elderberry bushes common to abundant, clumps of bushes commonly present, typically ranging in abundance from ≥ 5 to many bushes per acre.
2
Elderberry bushes common to infrequent, ranging from ≥ 1 bush per acre to 5 or more per acre.
3
Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered, often single bushes typically ≤ 1 bush per acre.
American River Watershed Investigation
U. S. Fish and Wildlife Service
Elderberry Distribution
Natomas Area
Map NCC #2
400 0 400 800 1200
SCALE OF FEET
N
CROSS
CANAL
OPEN WATER
DV
70% DV
MATCH LINE TO NCC #2


CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE
Category
Description
Color Code
1
Elderberry bushes common to abundant, clumps of bushes commonly present, typically ranging in abundance from ≥ 5 to many bushes per acre.
2
Elderberry bushes common to infrequent, ranging from ≥ 1 bush per acre to 5 or more per acre.
3
Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered, often single bushes typically ≤ 1 bush per acre.
American River Watershed Investigation
U. S. Fish and Wildlife Service
Elderberry Distribution
Natomas Area
Map NCC #3
FEATHER RIVER
SACRAMENTO RIVER
Cross Canal
Bars
N
400 0 400 800 1200
SCALE OF FEET
MATCH LINE TO SAC RIV #8
MATCH LINE TO SAC RIV #7
MATCH LINE TO NCC #2


MATCH LINE TO SAC RIV #1
OV
NATOMAS EAST MAIN DRAIN
DEL PASO BLVD
160
400 0 400 800 1200
SCALE OF FEET
AMERICAN
RIVER
R.M.2
N
CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE
Category
Description
Color Code
1
Elderberry bushes common to abundant, clumps of bushes commonly present, typically ranging in abundance from ≥ 5 to many bushes per acre.
2
Elderberry bushes common to infrequent, ranging from ≥ 1 bush per acre to 5 or more per acre.
3
Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered, often single bushes typically ≤ 1 bush per acre.
American River Watershed Investigation
U. S. Fish and Wildlife Service
Elderberry Distribution
Natomas Area
Map NEMD #1


MATCH LINE TO NEMD #1
MATCH LINE TO NEMD #3
NATOMAS
EAST
MAIN
DRAIN
ARCADE
CREEK
N
OV
40% OV
BARE GROUND
35% OV, 20% PFO
80% OV
10% OV
400 0 400 800 1200
SCALE OF FEET
CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE
Category
Description
Color Code
1
Elderberry bushes common to abundant, clumps of bushes commonly present, typically ranging in abundance from ≥ 5 to many bushes per acre.
2
Elderberry bushes common to infrequent, ranging from ≥ 1 bush per acre to 5 or more per acre.
3
Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered, often single bushes typically ≤ 1 bush per acre.
American River Watershed Investigation
U. S. Fish and Wildlife Service
Elderberry Distribution
Natomas Area
Map NEMD #2





CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE

Category	Description	Color Code
1	Elderberry bushes common to abundant, clumps of bushes commonly present, typically ranging in abundance from $\geq$ 5 to many bushes per acre.	●
2	Elderberry bushes common to infrequent, ranging from $\geq$ 1 bush per acre to 5 or more per acre.	●
3	Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered, often single bushes typically $\leq$ 1 bush per acre.	

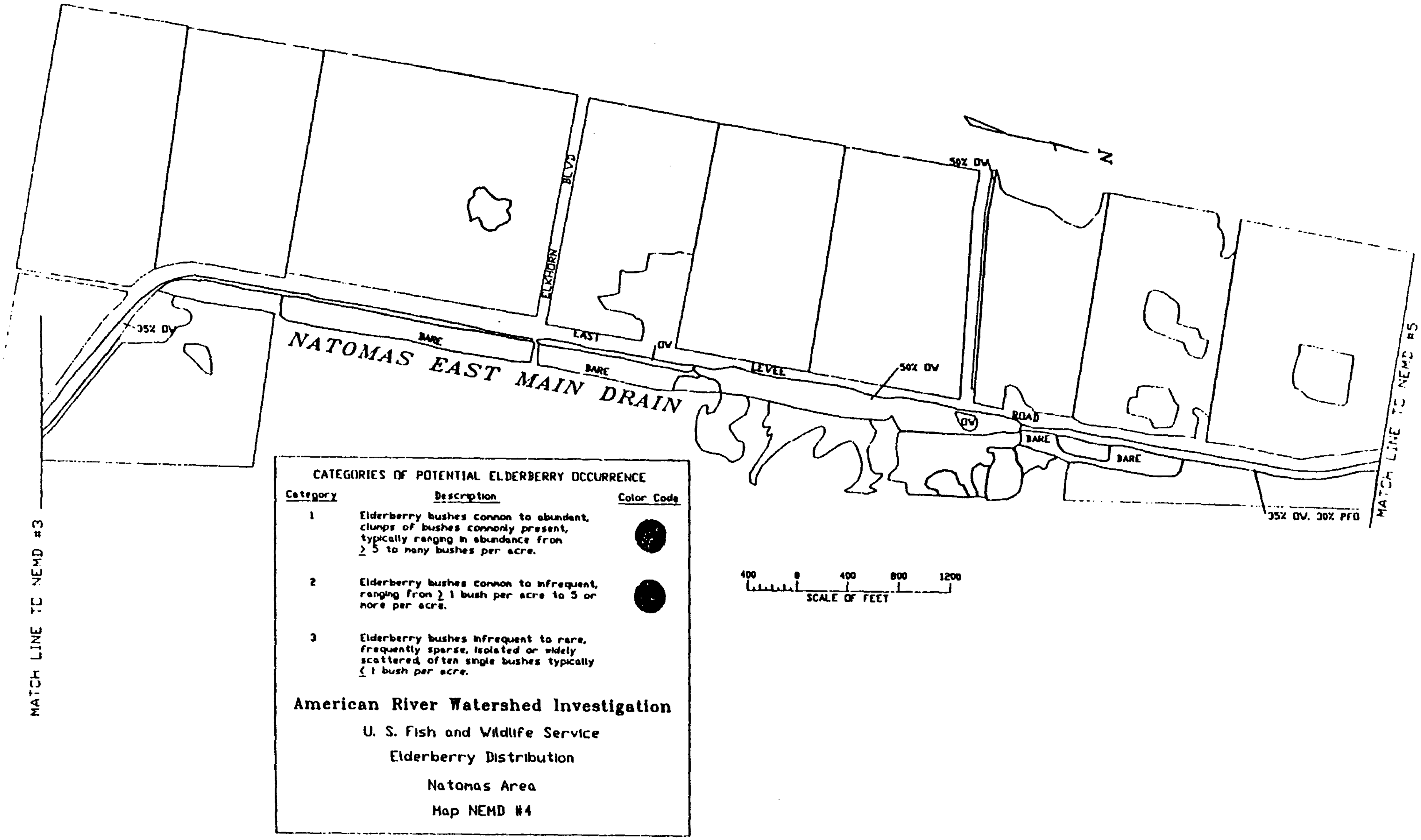
American River Watershed Investigation

U. S. Fish and Wildlife Service

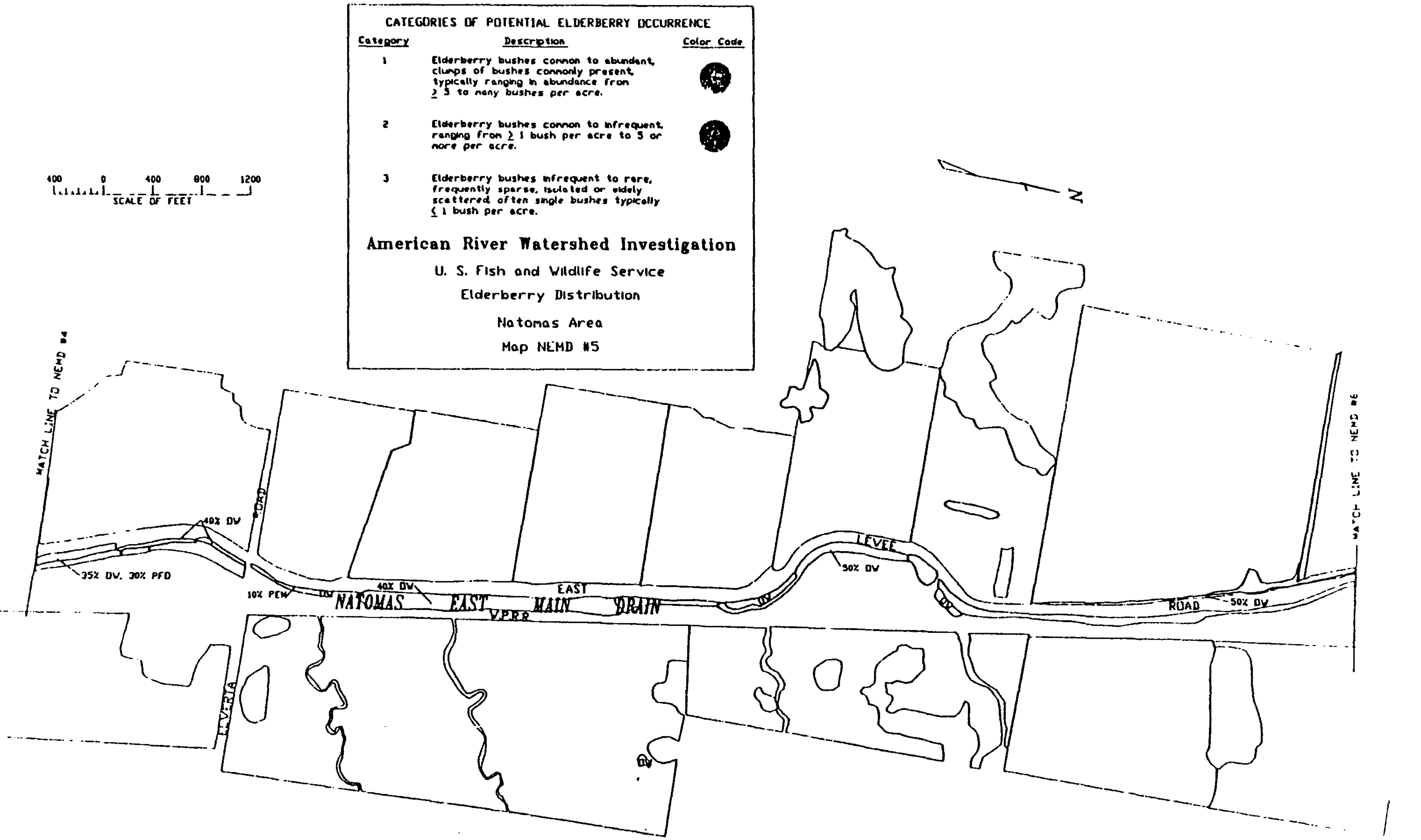
Elderberry Distribution

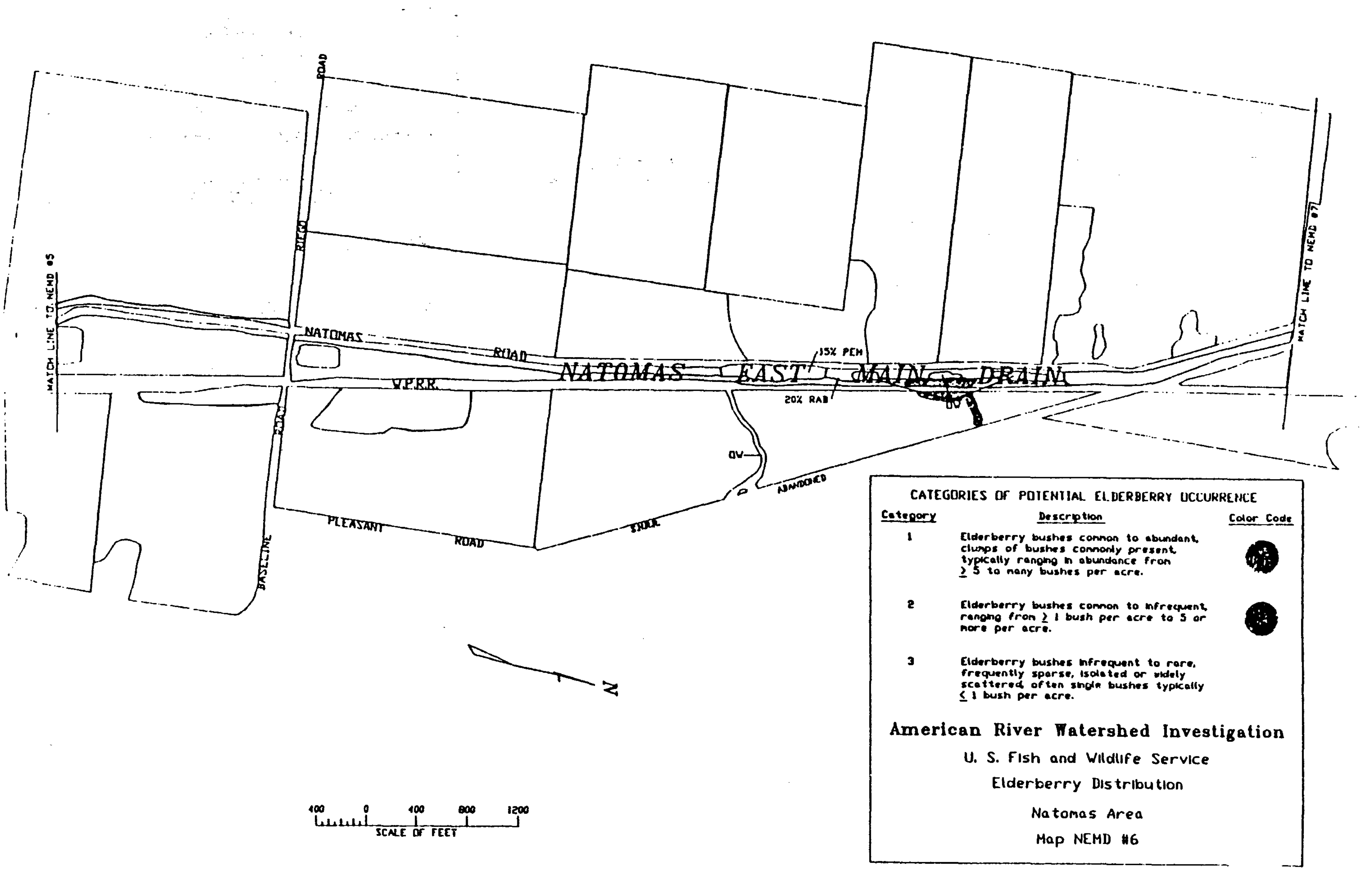
Natomas Area

Map NEMD #3

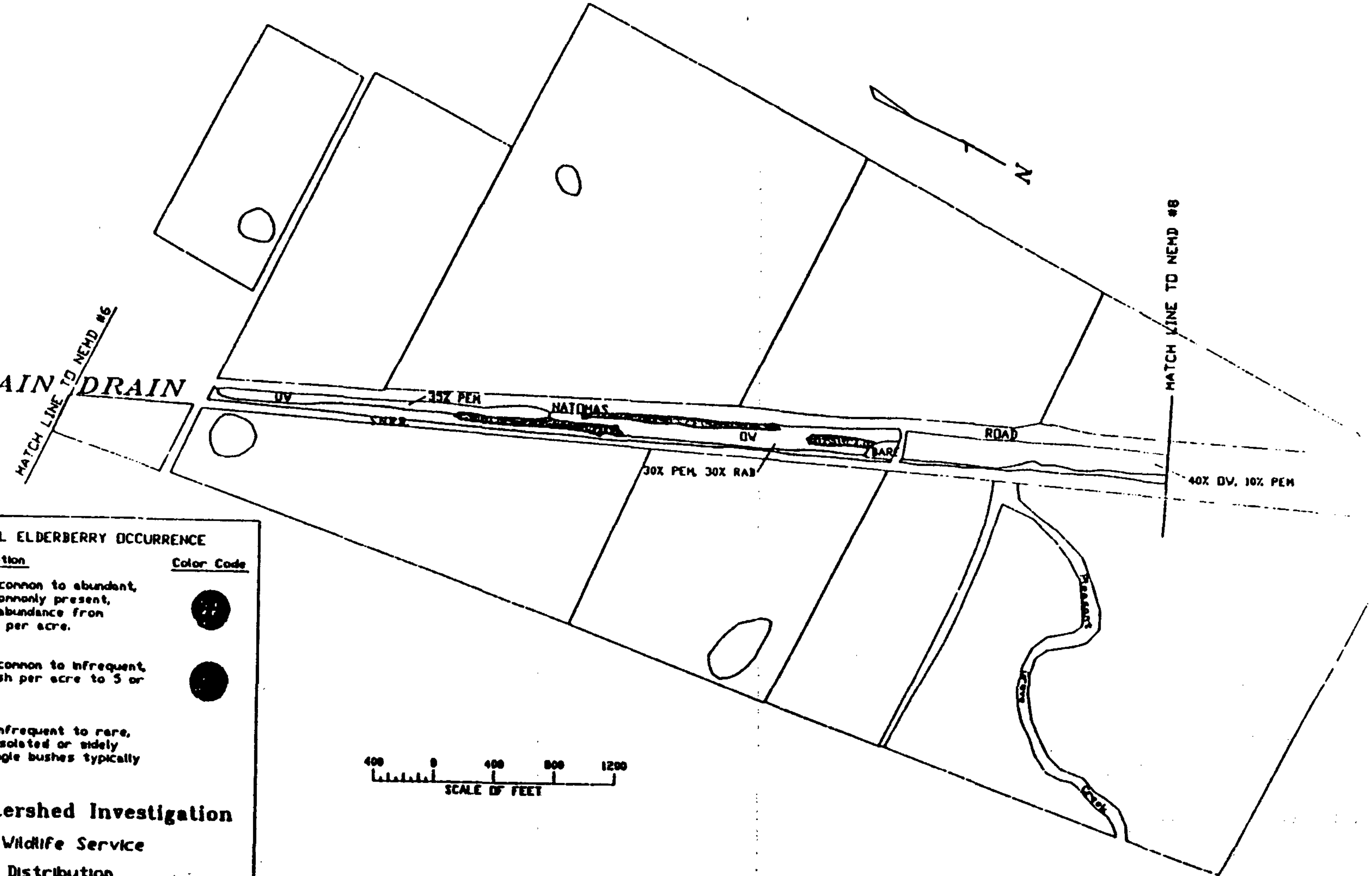


MATCH LINE TO NEMD #3
MATCH LINE TO NEMD #5
N
35% DV
BARE
BARE
NATOMAS EAST MAIN DRAIN
ELKHORN BLVD
EAST
DV
LEVEE
50% DV
50% DV
DV
ROAD
BARE
BARE
35% DV, 30% PFD
400 0 400 800 1200
SCALE OF FEET
CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE
Category
Description
Color Code
1
Elderberry bushes common to abundant, clumps of bushes commonly present, typically ranging in abundance from ≥ 5 to many bushes per acre.
2
Elderberry bushes common to infrequent, ranging from ≥ 1 bush per acre to 5 or more per acre.
3
Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered, often single bushes typically ≤ 1 bush per acre.
American River Watershed Investigation
U. S. Fish and Wildlife Service
Elderberry Distribution
Natomas Area
Map NEMD #4


CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE
Category | Description | Color Code
1 Elderberry bushes common to abundant, clumps of bushes commonly present, typically ranging in abundance from ≥ 5 to many bushes per acre.
2 Elderberry bushes common to infrequent, ranging from ≥ 1 bush per acre to 5 or more per acre.
3 Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered, often single bushes typically ≤ 1 bush per acre.
American River Watershed Investigation
U. S. Fish and Wildlife Service
Elderberry Distribution
Natomas Area
Map NEMD #5
400 0 400 800 1200
SCALE OF FEET
N
MATCH LINE TO NEMD #4
MATCH LINE TO NEMD #6
40% DV
35% DV, 30% PFD
ROAD
10% PEW
DV
40% DV
NATOMAS EAST MAIN DRAIN
EAST
V.P.R.R.
LEVEE
50% DV
ROAD
50% DV
DV
ELVERTA



MATCH LINE TO NEMD #5
MATCH LINE TO NEMD #7
NATOMAS ROAD
NATOMAS EAST MAIN DRAIN
W.P.R.R.
RIEGO ROAD
BASELINE ROAD
PLEASANT ROAD
15% PEM
20% RAB
OV
ABANDONED
N
400 0 400 800 1200
SCALE OF FEET
CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE
Category
Description
Color Code
1
Elderberry bushes common to abundant, clumps of bushes commonly present, typically ranging in abundance from ≥ 5 to many bushes per acre.
2
Elderberry bushes common to infrequent, ranging from ≥ 1 bush per acre to 5 or more per acre.
3
Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered, often single bushes typically ≤ 1 bush per acre.
American River Watershed Investigation
U. S. Fish and Wildlife Service
Elderberry Distribution
Natomas Area
Map NEMD #6



CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE

Category	Description	Color Code
1	Elderberry bushes common to abundant, clumps of bushes commonly present, typically ranging in abundance from ≥ 5 to many bushes per acre.	
2	Elderberry bushes common to infrequent, ranging from ≥ 1 bush per acre to 5 or more per acre.	
3	Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered, often single bushes typically ≤ 1 bush per acre.	

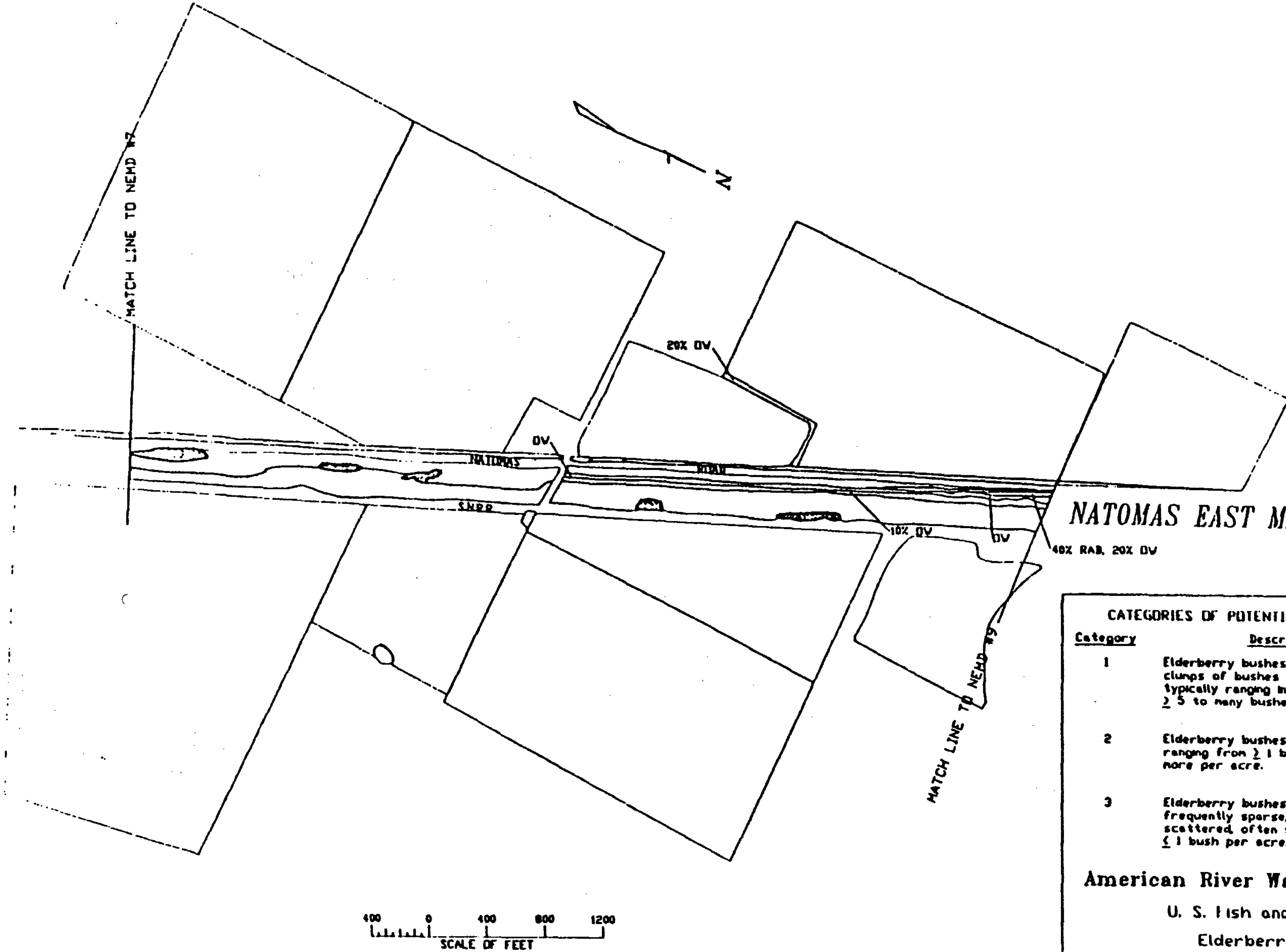
American River Watershed Investigation

U. S. Fish and Wildlife Service

Elderberry Distribution

Natomas Area

Map NEMD #7



NATOMAS EAST MAIN DRAIN

CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE

Category	Description	Color Code
1	Elderberry bushes common to abundant, clumps of bushes commonly present, typically ranging in abundance from ≥ 5 to many bushes per acre.	
2	Elderberry bushes common to infrequent, ranging from ≥ 1 bush per acre to 5 or more per acre.	
3	Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered, often single bushes typically ≤ 1 bush per acre.	

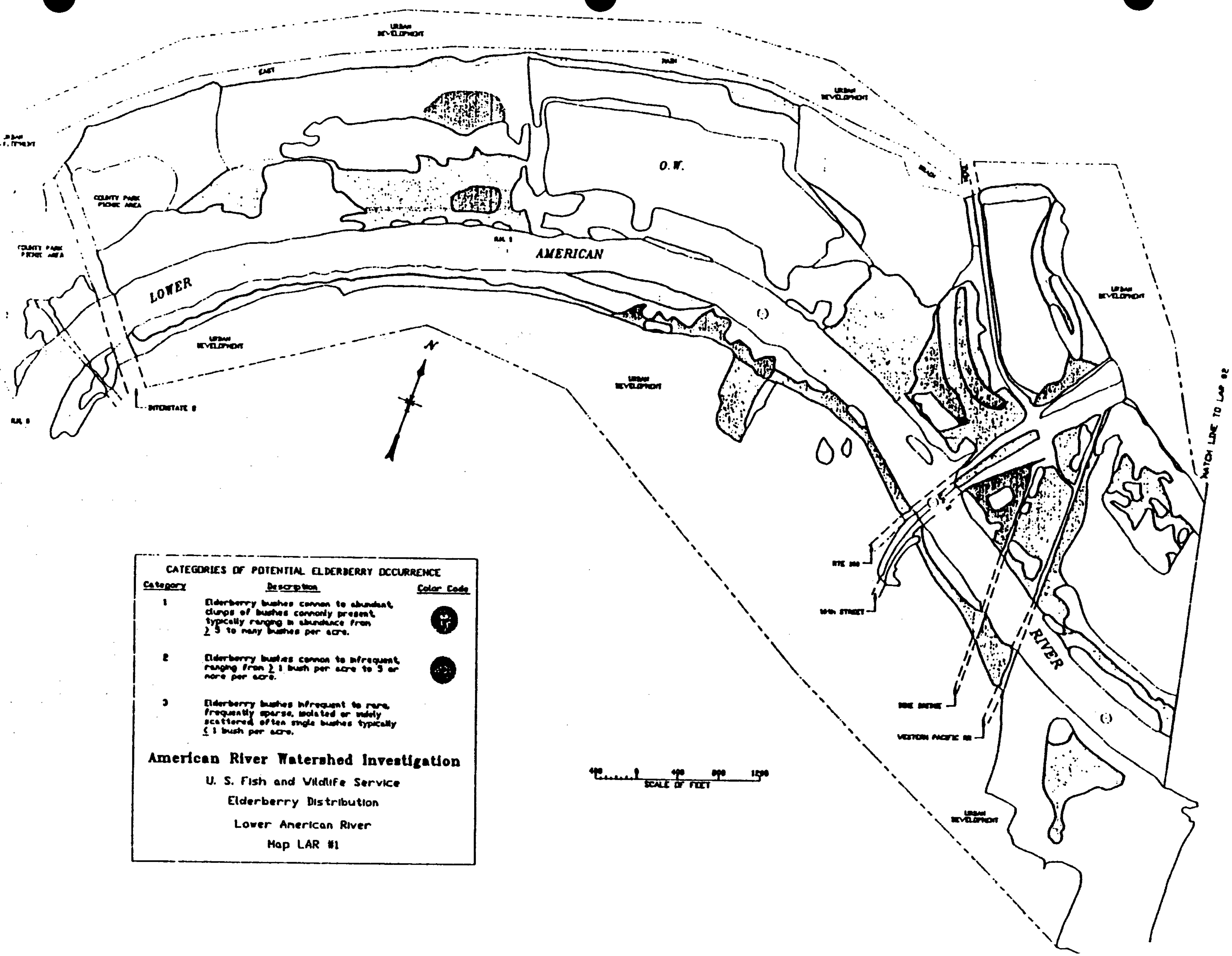
American River Watershed Investigation

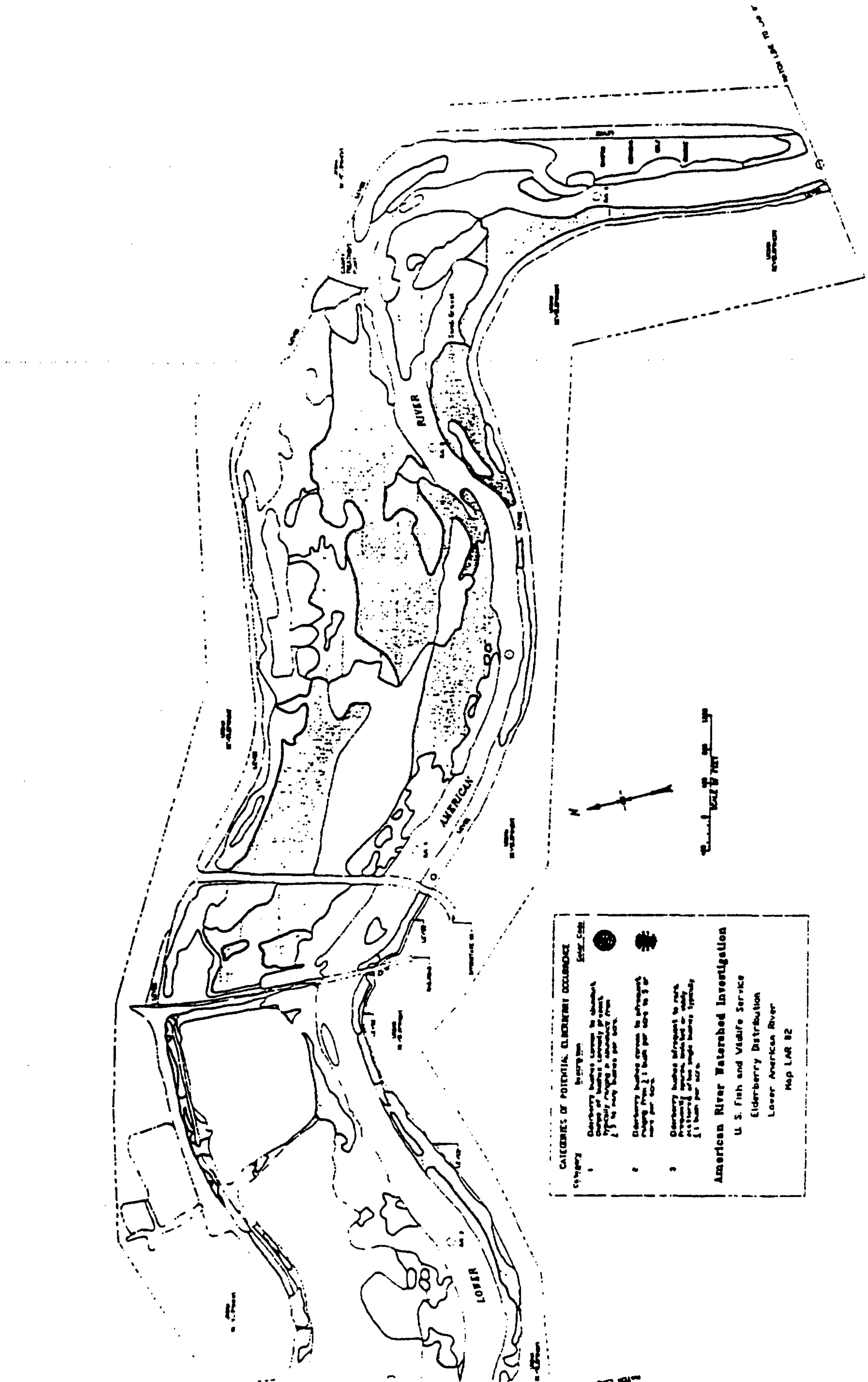
U. S. Fish and Wildlife Service

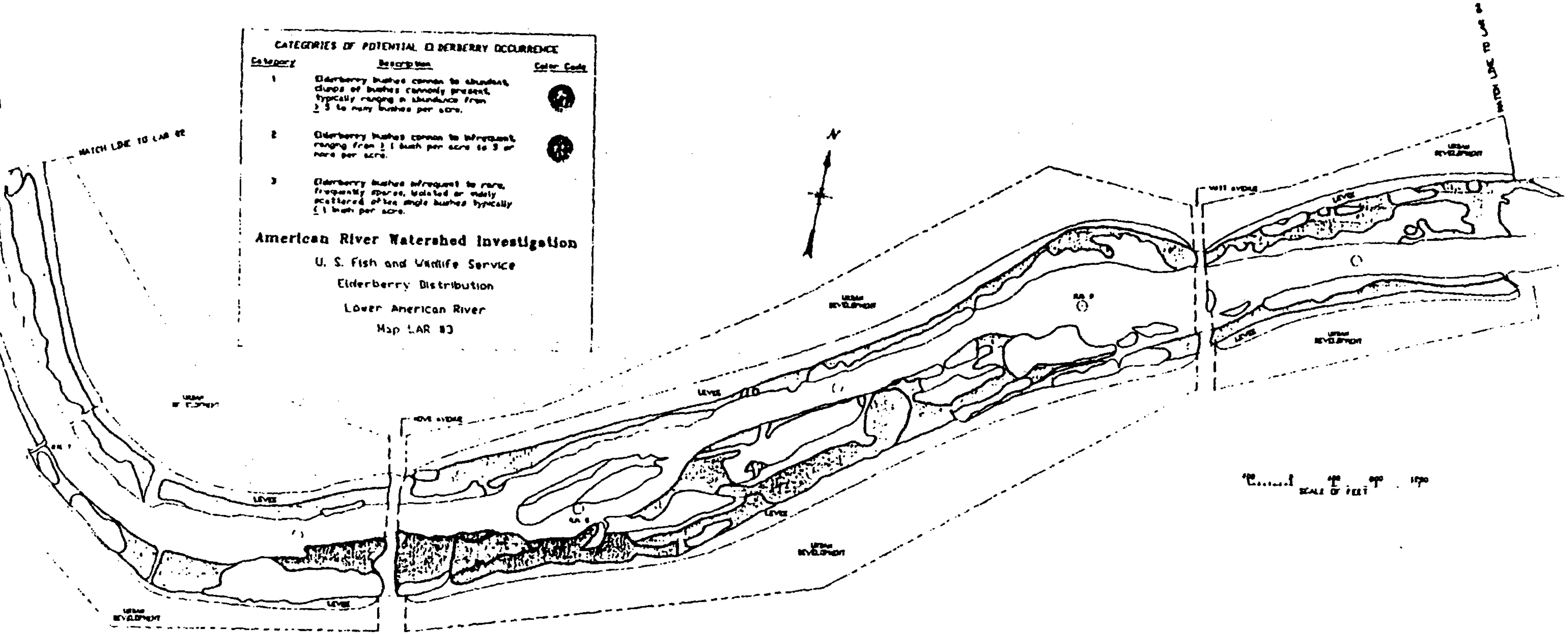
Elderberry Distribution

Natomas Area

Map NEMD #8


URBAN DEVELOPMENT
EAST
MAIN
O.W.
COUNTY PARK PICNIC AREA
LOWER
AMERICAN
RIVER
INTERSTATE 5
RTE 160
16th STREET
WESTERN PACIFIC RR
MATCH LINE TO LAR #2
N
400 0 400 800 1200
SCALE OF FEET
CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE
Category
Description
Color Code
1
Elderberry bushes common to abundant, clumps of bushes commonly present, typically ranging in abundance from ≥ 5 to many bushes per acre.
2
Elderberry bushes common to infrequent, ranging from ≥ 1 bush per acre to 5 or more per acre.
3
Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered, often single bushes typically ≤ 1 bush per acre.
American River Watershed Investigation
U. S. Fish and Wildlife Service
Elderberry Distribution
Lower American River
Map LAR #1


CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE
American River Watershed Investigation
U. S. Fish and Wildlife Service
Elderberry Distribution
Lower American River
Map LAR 82
LOWER
AMERICAN
RIVER



CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE
Category
Description
Color Code
1
Elderberry bushes common to abundant, clumps of bushes commonly present, typically ranging in abundance from ≥ 5 to many bushes per acre.
2
Elderberry bushes common to infrequent, ranging from ≥ 1 bush per acre to 5 or more per acre.
3
Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered of less single bushes typically ≤ 1 bush per acre.
American River Watershed Investigation
U. S. Fish and Wildlife Service
Elderberry Distribution
Lower American River
Map LAR #3
N
LEVEE
URBAN DEVELOPMENT
SCALE OF FEET

CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE

Category	Description	Color Code
1	Elderberry bushes common to abundant, clumps of bushes commonly present, typically ranging in abundance from ≥ 5 to many bushes per acre.	
2	Elderberry bushes common to infrequent, ranging from ≥ 1 bush per acre to 5 or more per acre.	
3	Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered, often single bushes typically ≤ 1 bush per acre.	

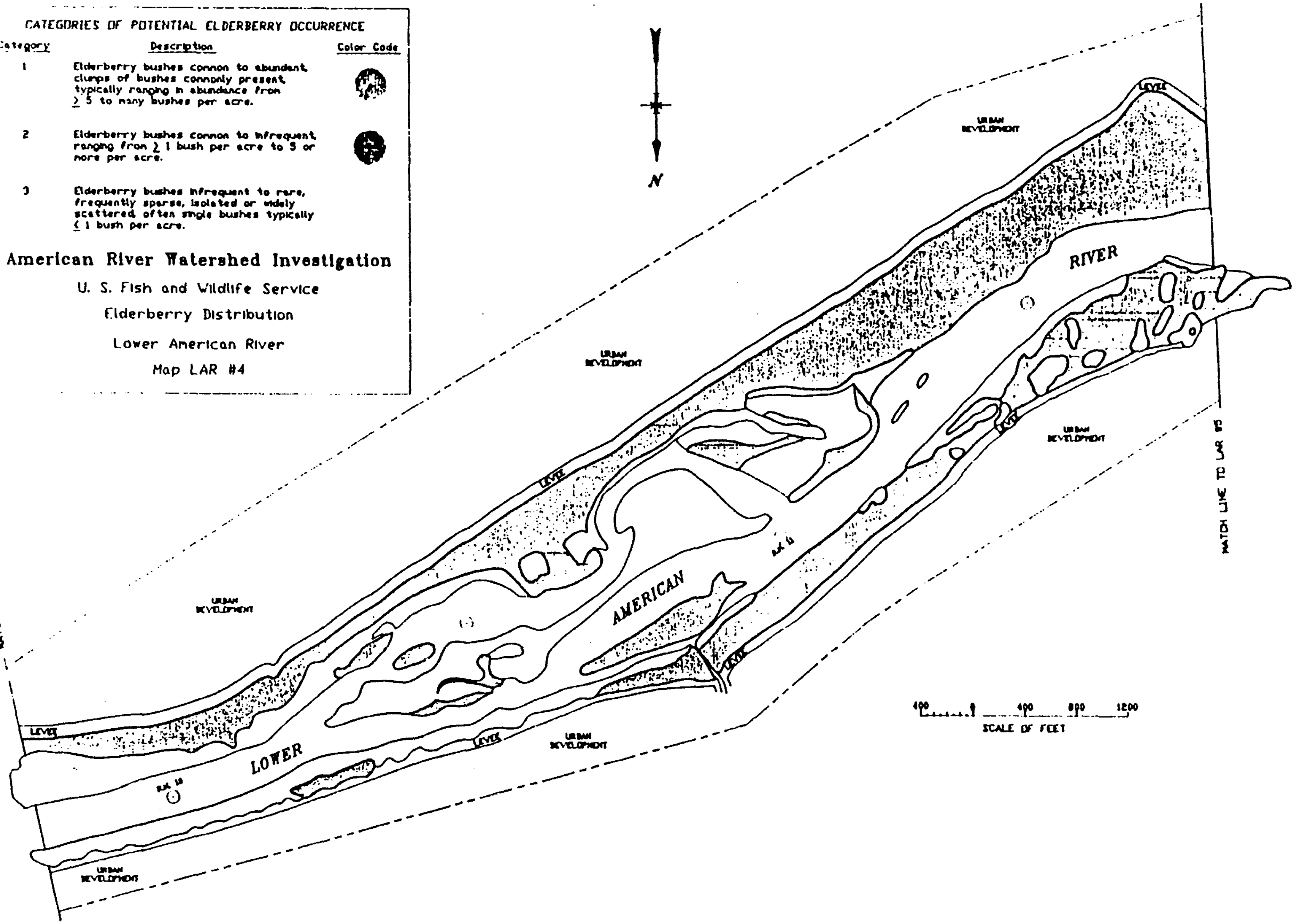
American River Watershed Investigation

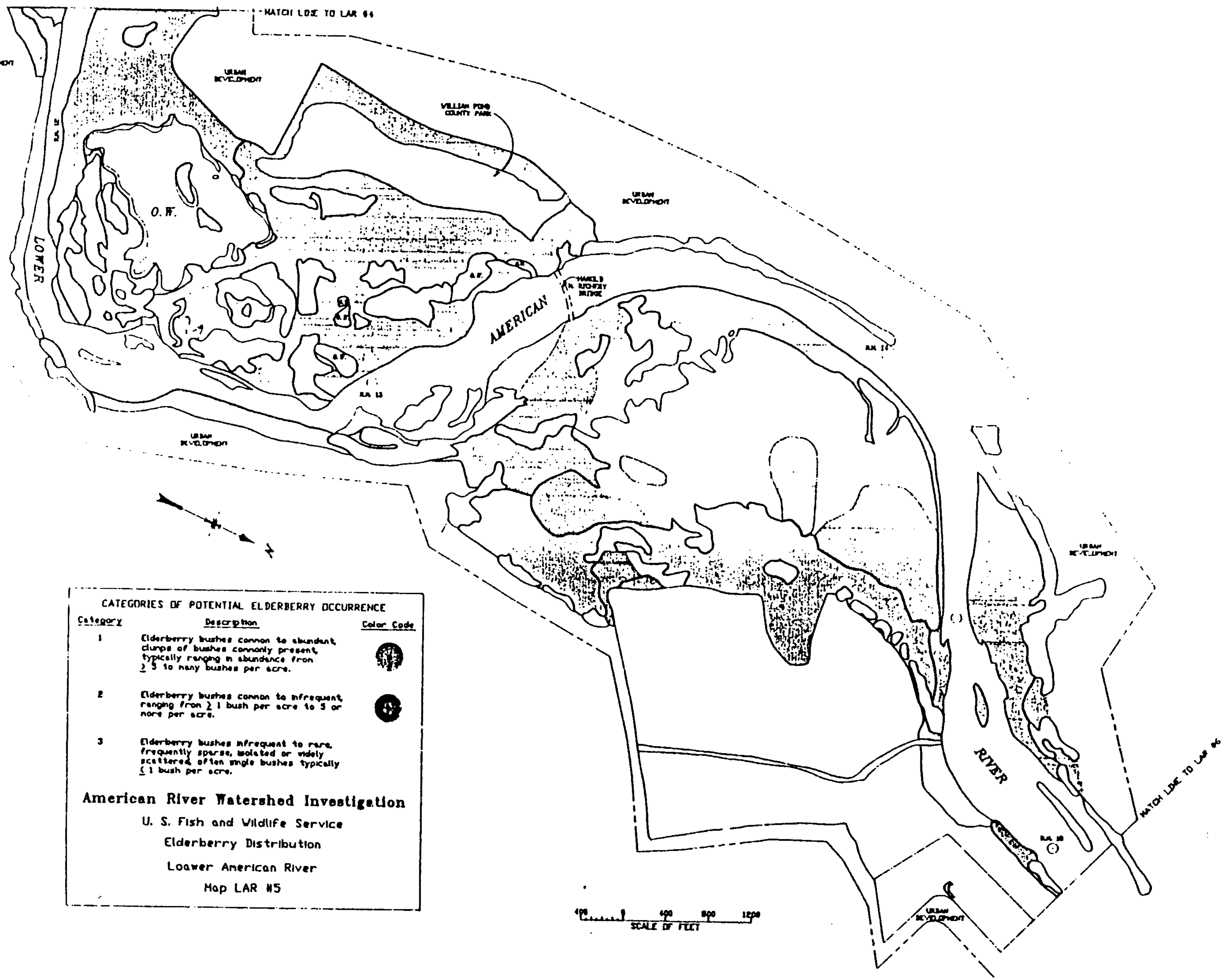
U. S. Fish and Wildlife Service

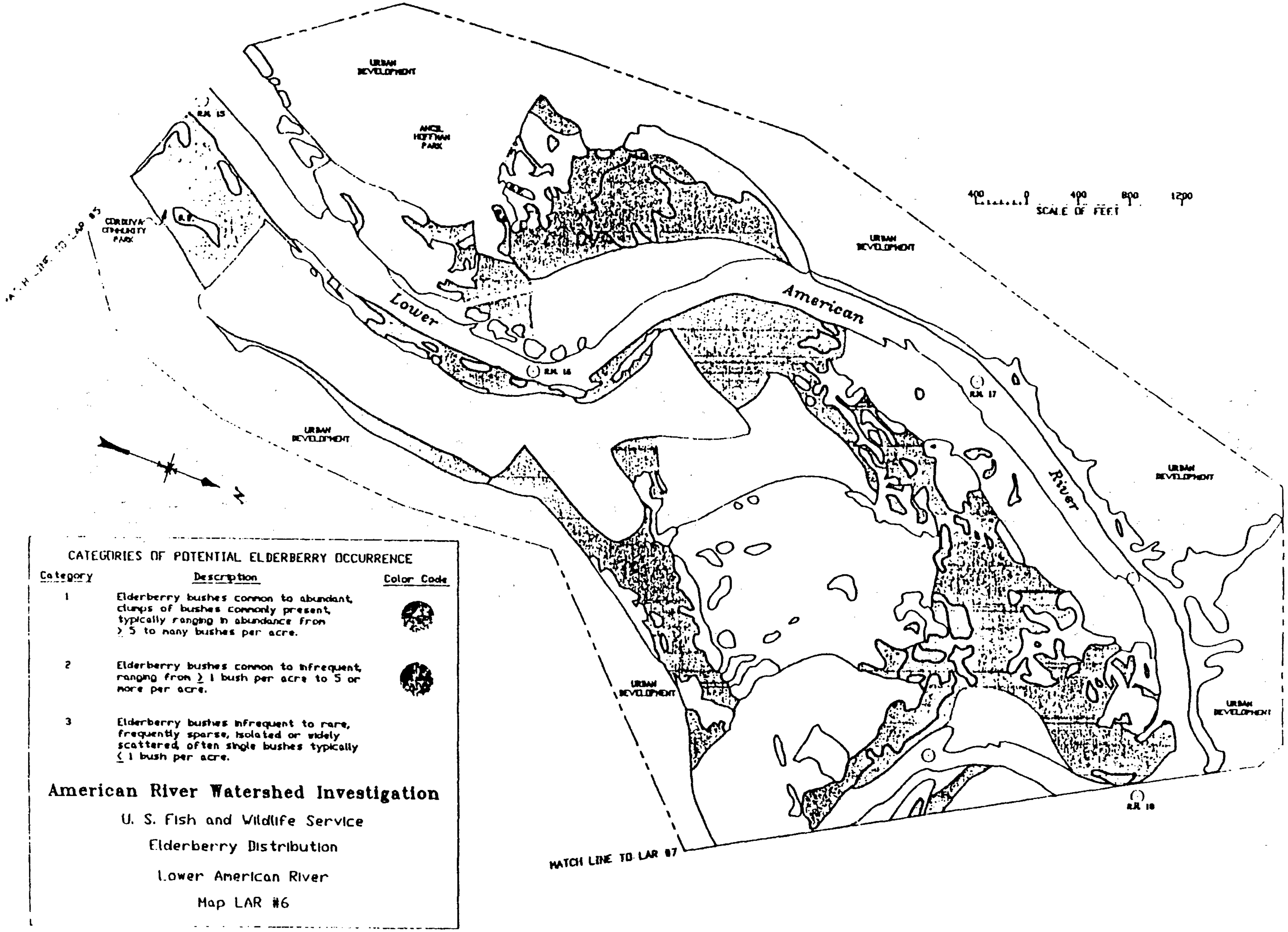
Elderberry Distribution

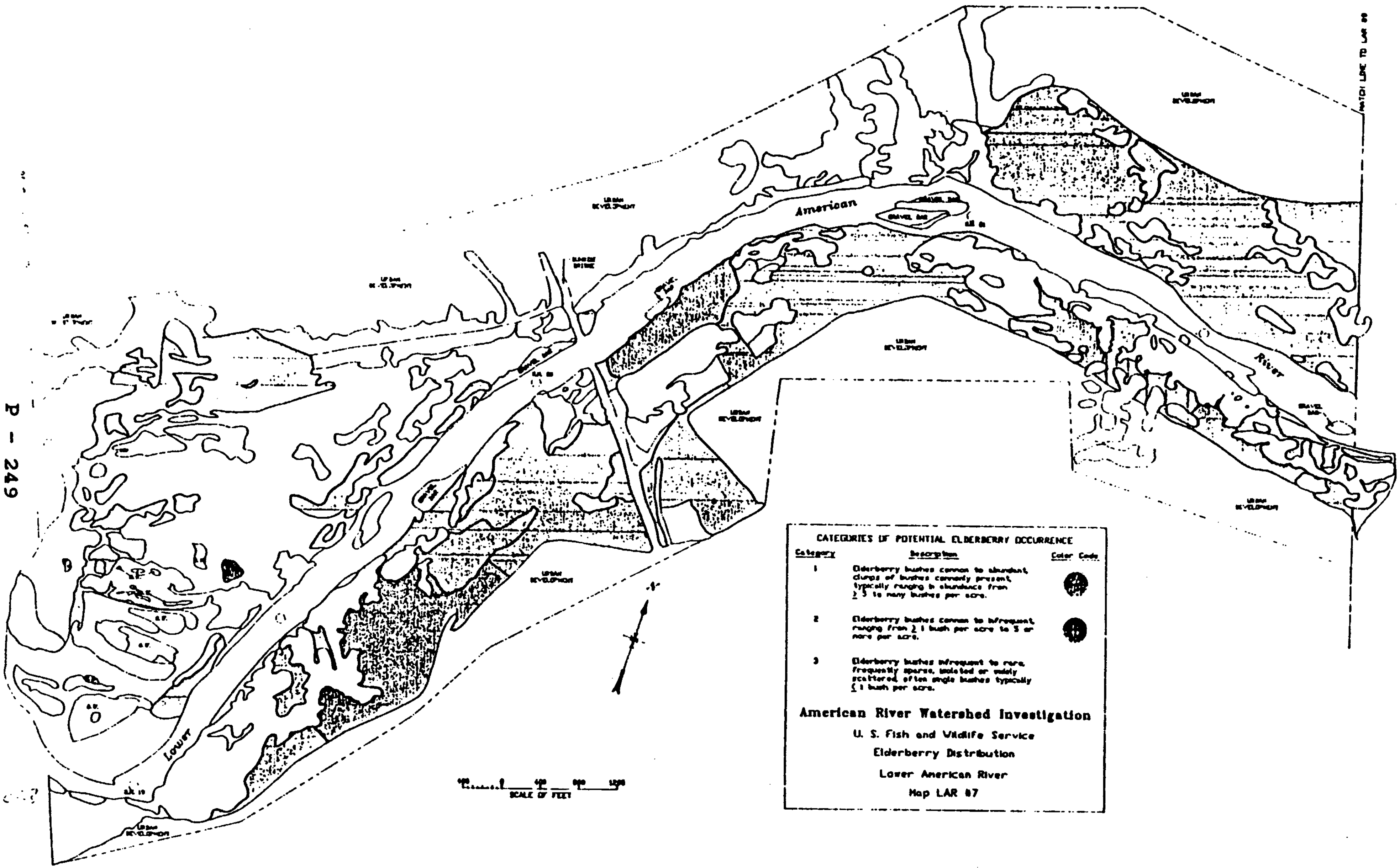
Lower American River

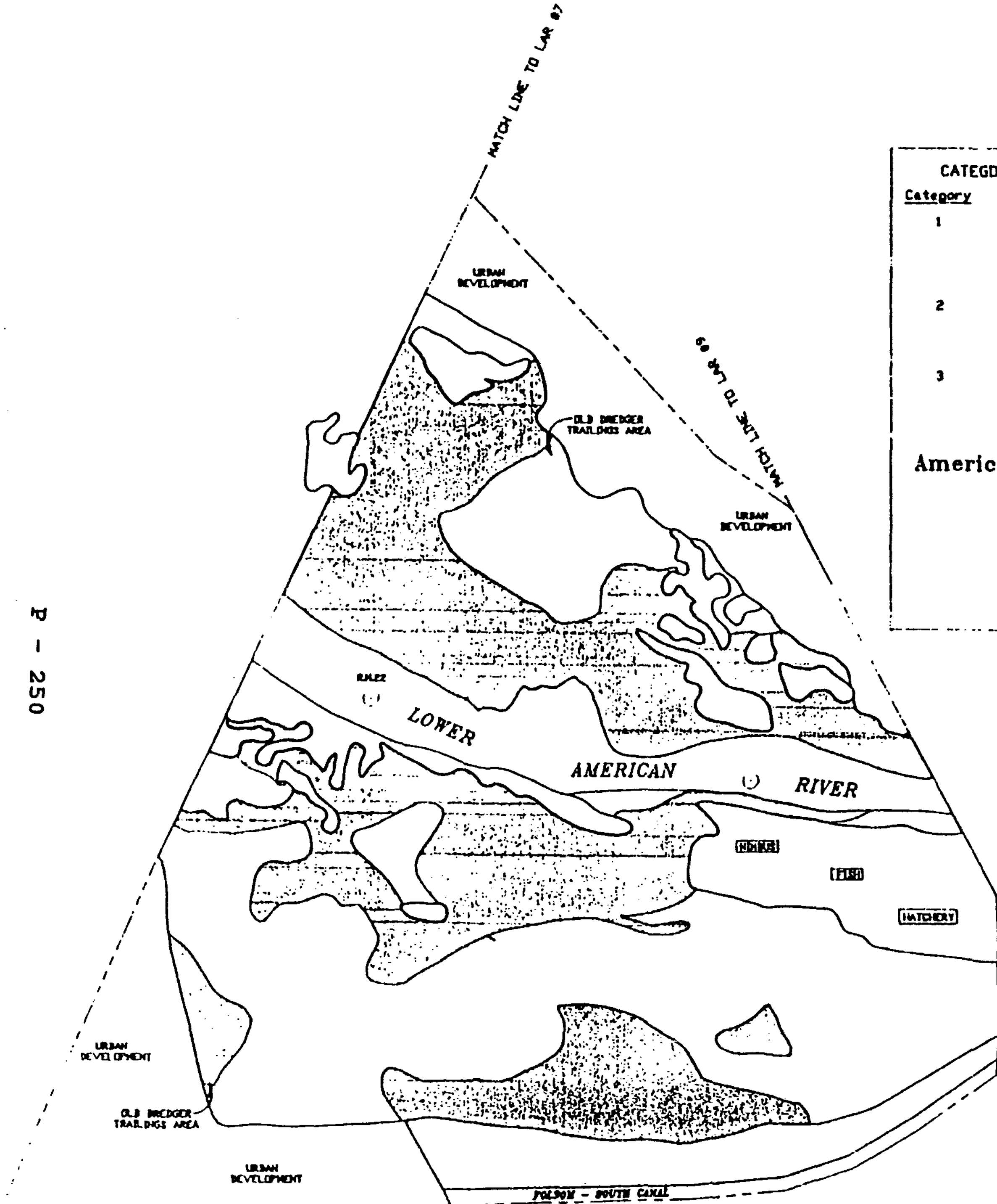
Map LAR #4




MATCH LINE TO LAR #4
URBAN DEVELOPMENT
WILLIAM POND COUNTY PARK
O.W.
LOWER
AMERICAN
RIVER
MATCH LINE TO LAR #6
400 0 400 800 1200
SCALE OF FEET
CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE
Category
Description
Color Code
1
Elderberry bushes common to abundant, clumps of bushes commonly present, typically ranging in abundance from ≥ 5 to many bushes per acre.
2
Elderberry bushes common to infrequent, ranging from ≥ 1 bush per acre to 5 or more per acre.
3
Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered, often single bushes typically ≤ 1 bush per acre.
American River Watershed Investigation
U. S. Fish and Wildlife Service
Elderberry Distribution
Loawer American River
Map LAR #5


URBAN DEVELOPMENT
ANCIL HOFFMAN PARK
R.M. 15
CORDOVA COMMUNITY PARK
MATCH LINE TO LAR #5
Lower
American
River
R.M. 16
R.M. 17
R.M. 18
URBAN DEVELOPMENT
URBAN DEVELOPMENT
URBAN DEVELOPMENT
URBAN DEVELOPMENT
URBAN DEVELOPMENT
400 0 400 800 1200
SCALE OF FEET
N
MATCH LINE TO LAR #7
CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE
Category Description Color Code
1 Elderberry bushes common to abundant, clumps of bushes commonly present, typically ranging in abundance from > 5 to many bushes per acre.
2 Elderberry bushes common to infrequent, ranging from ≥ 1 bush per acre to 5 or more per acre.
3 Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered, often single bushes typically ≤ 1 bush per acre.
American River Watershed Investigation
U. S. Fish and Wildlife Service
Elderberry Distribution
Lower American River
Map LAR #6


CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE
Category
Description
Color Code
1
Elderberry bushes common to abundant, clumps of bushes commonly present, typically ranging in abundance from ≥ 5 to many bushes per acre.
2
Elderberry bushes common to infrequent, ranging from ≥ 1 bush per acre to 5 or more per acre.
3
Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered, often single bushes typically ≤ 1 bush per acre.
American River Watershed Investigation
U. S. Fish and Wildlife Service
Elderberry Distribution
Lower American River
Map LAR 87
American
River
Lower
SCALE OF FEET
URBAN DEVELOPMENT
GRAVEL BAR



CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE

Category	Description	Color Code
1	Elderberry bushes common to abundant, clumps of bushes commonly present, typically ranging in abundance from ≥ 5 to many bushes per acre.	
2	Elderberry bushes common to infrequent, ranging from ≥ 1 bush per acre to 5 or more per acre.	
3	Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered, often single bushes typically ≤ 1 bush per acre.	

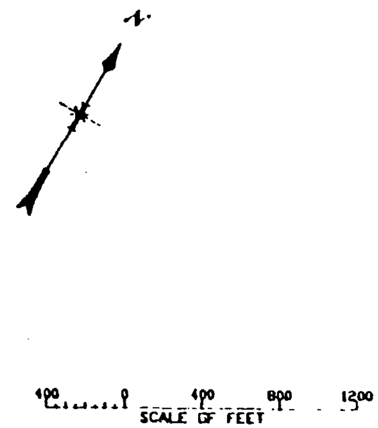
American River Watershed Investigation

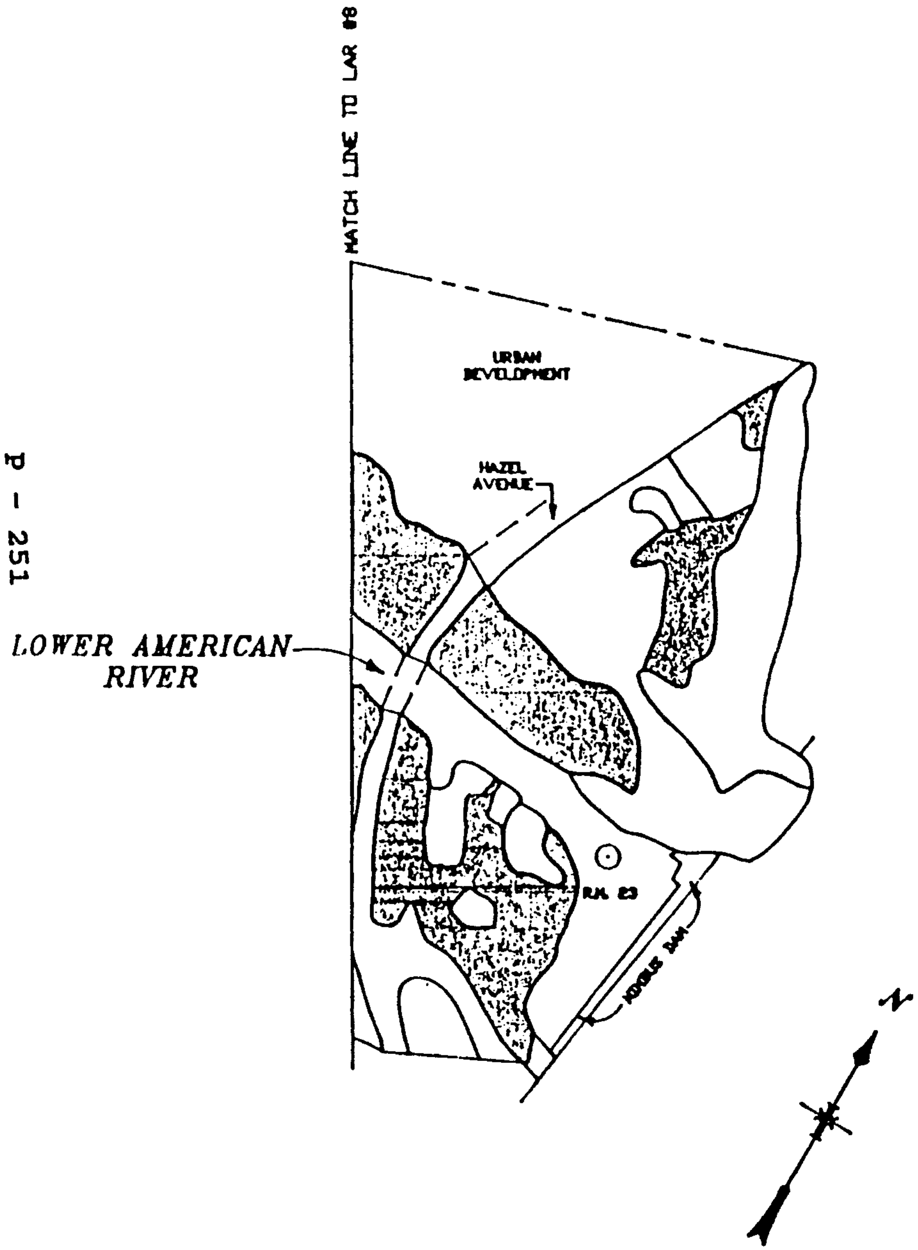
U. S. Fish and Wildlife Service

Elderberry Distribution

Lower American River

Map LAR #8





400 0 400 800 1200
SCALE OF FEET

CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE

Category	Description	Color Code
1	Elderberry bushes common to abundant, clumps of bushes commonly present, typically ranging in abundance from $\geq$ 5 to many bushes per acre.	
2	Elderberry bushes common to infrequent, ranging from $\geq$ 1 bush per acre to 5 or more per acre.	
3	Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered, often single bushes typically $\leq$ 1 bush per acre.	

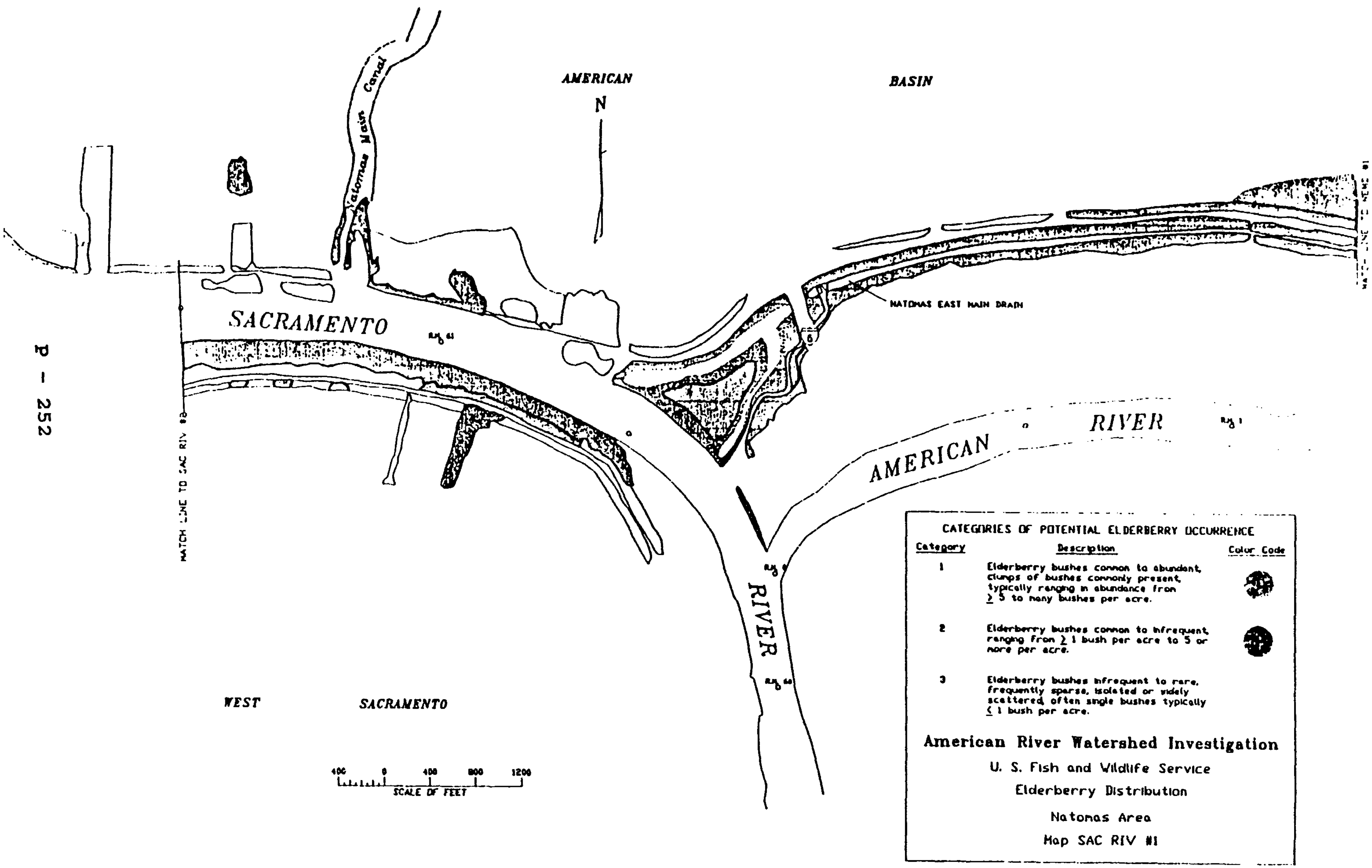
American River Watershed Investigation

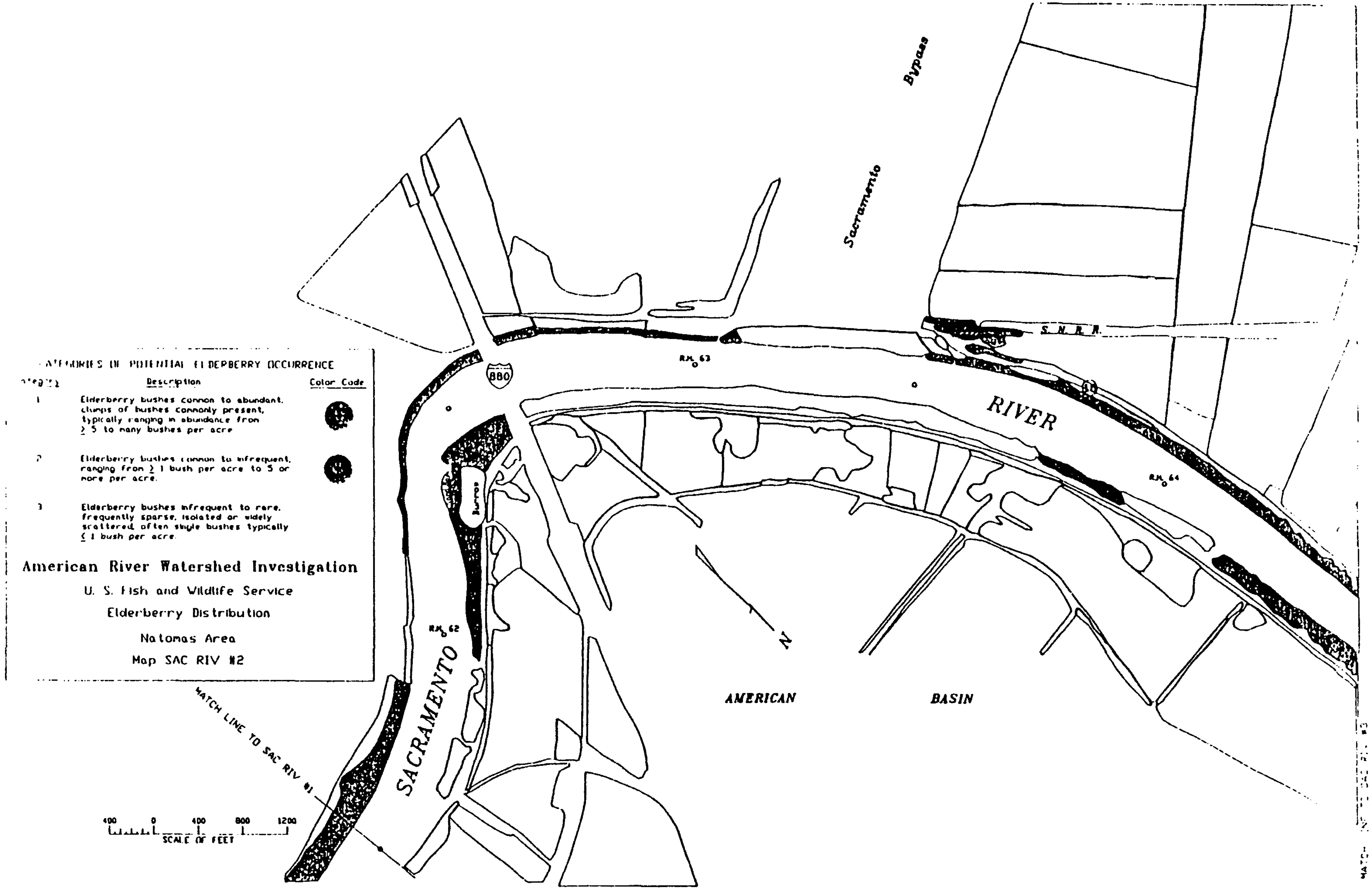
U. S. Fish and Wildlife Service

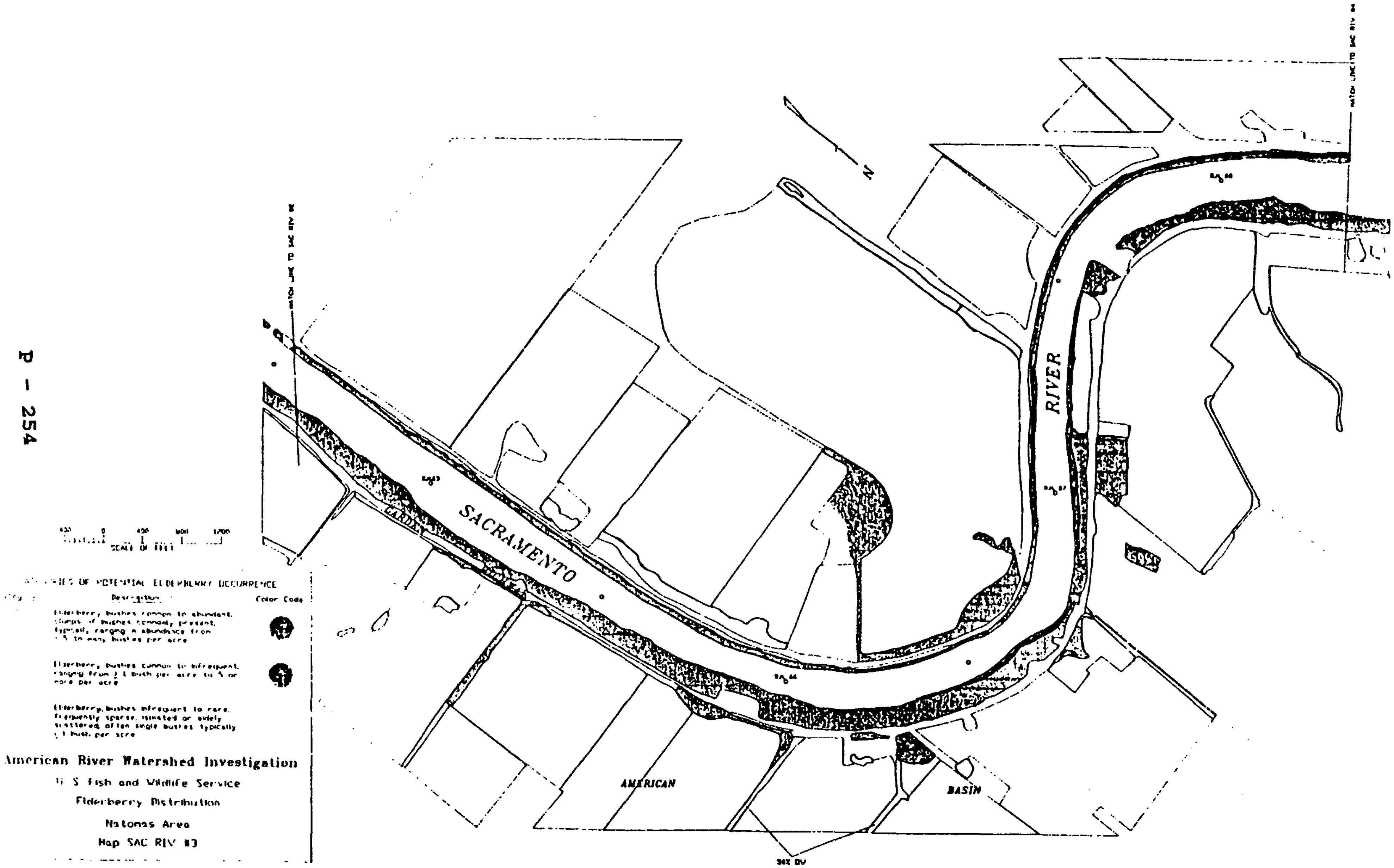
Elderberry Distribution

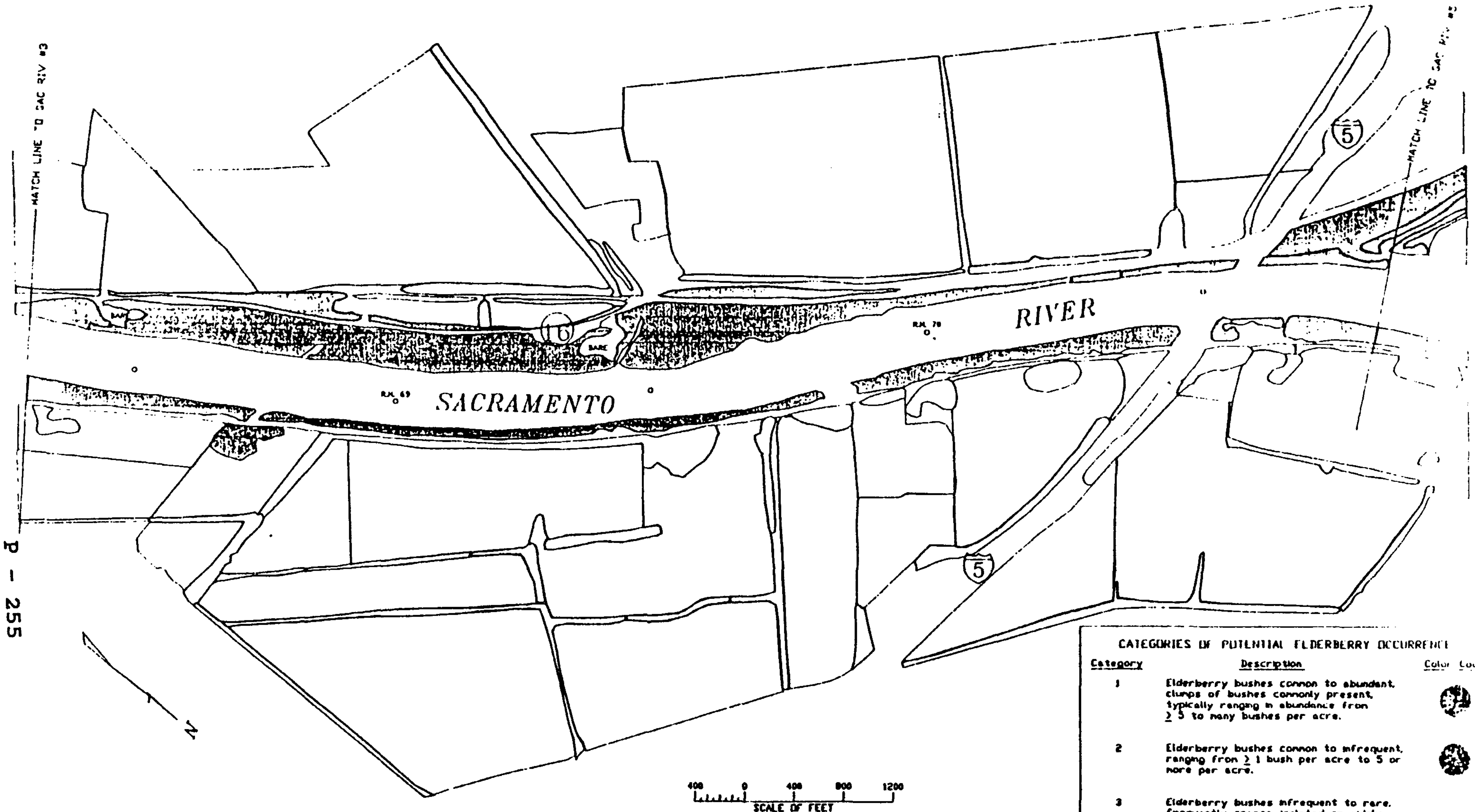
Lower American River

Map LAR #9


AMERICAN
BASIN
N
Natomas Main Canal
NATOMAS EAST MAIN DRAIN
SACRAMENTO
RIVER
AMERICAN
RIVER
MATCH LINE TO SAC RIV #2
WEST
SACRAMENTO
400 0 400 800 1200
SCALE OF FEET
CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE
Category
Description
Color Code
1
Elderberry bushes common to abundant, clumps of bushes commonly present, typically ranging in abundance from ≥ 5 to many bushes per acre.
2
Elderberry bushes common to infrequent, ranging from ≥ 1 bush per acre to 5 or more per acre.
3
Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered, often single bushes typically ≤ 1 bush per acre.
American River Watershed Investigation
U. S. Fish and Wildlife Service
Elderberry Distribution
Natomas Area
Map SAC RIV #1


CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE
Category
Description
Color Code
1
Elderberry bushes common to abundant, clumps of bushes commonly present, typically ranging in abundance from ≥ 5 to many bushes per acre
2
Elderberry bushes common to infrequent, ranging from ≥ 1 bush per acre to 5 or more per acre.
3
Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered, often single bushes typically ≤ 1 bush per acre.
American River Watershed Investigation
U. S. Fish and Wildlife Service
Elderberry Distribution
Natomas Area
Map SAC RIV #2
MATCH LINE TO SAC RIV #1
400 0 400 800 1200
SCALE OF FEET
Sacramento
Bypass
S. N. R. R.
RIVER
SACRAMENTO
R.M. 62
R.M. 63
R.M. 64
880
Burros
N
AMERICAN
BASIN


MATCH LINE TO SAC RIV #4
MATCH LINE TO SAC RIV #2
N
RIVER
SACRAMENTO
GARDEN
AMERICAN
BASIN
400 0 400 800 1200
SCALE OF FEET
CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE
Description
Color Code
Elderberry bushes common to abundant. Clumps of bushes commonly present, typically ranging in abundance from ≥5 to many bushes per acre
Elderberry bushes common to infrequent, ranging from ≥1 bush per acre to 5 or more per acre
Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered, often single bushes typically ≤1 bush per acre
American River Watershed Investigation
U S Fish and Wildlife Service
Elderberry Distribution
Natomas Area
Map SAC RIV #3



CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE

Category	Description	Color Code
1	Elderberry bushes common to abundant, clumps of bushes commonly present, typically ranging in abundance from ≥ 5 to many bushes per acre.	
2	Elderberry bushes common to infrequent, ranging from ≥ 1 bush per acre to 5 or more per acre.	
3	Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered, often single bushes typically ≤ 1 bush per acre.	

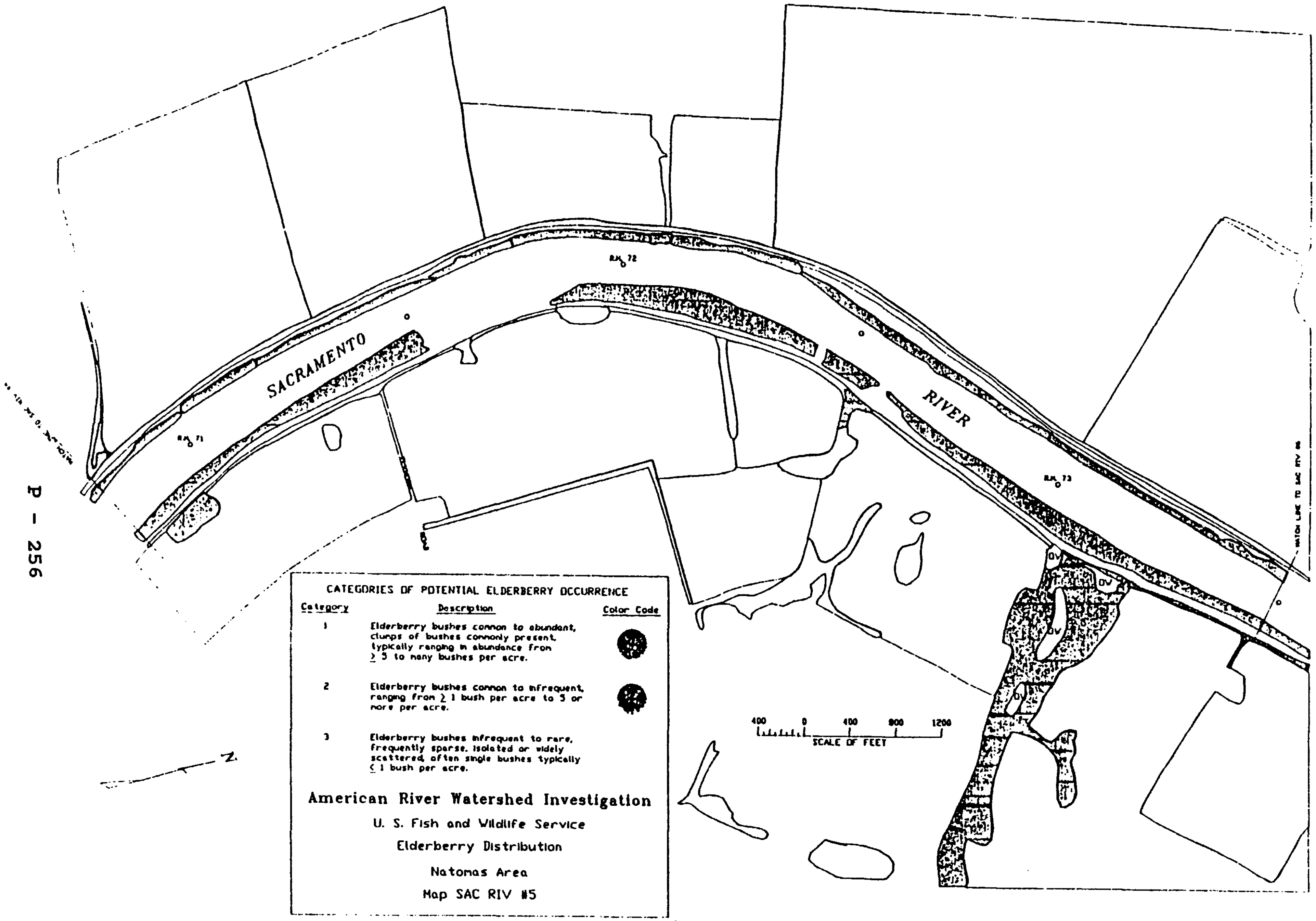
American River Watershed Investigation

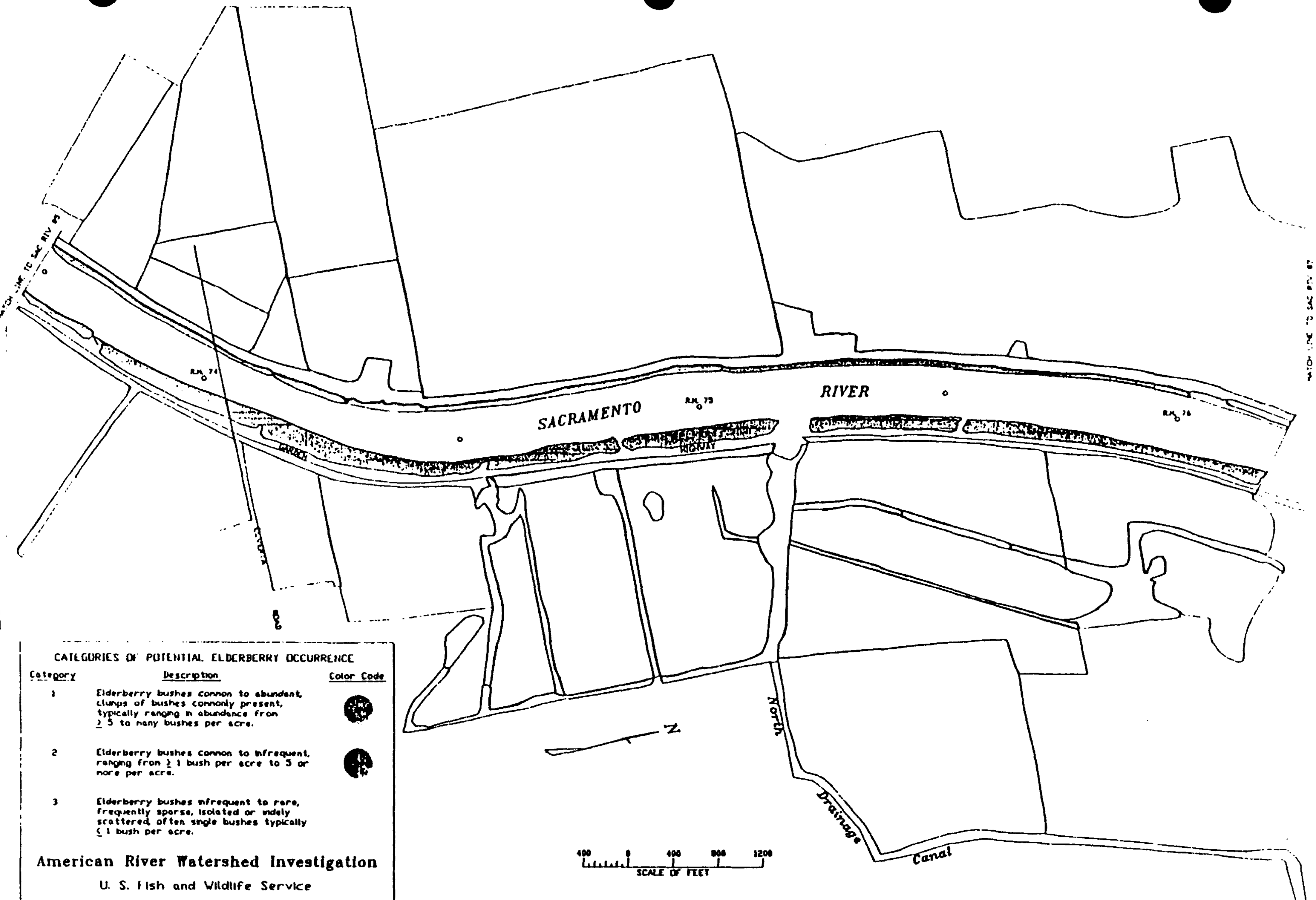
U. S. Fish and Wildlife Service

Elderberry Distribution

Natomas Area

Map SAC RIV #4


SACRAMENTO
RIVER
R.M. 71
R.M. 72
R.M. 73
MATCH LINE TO SAC RIV #6
OV
N
400 0 400 800 1200
SCALE OF FEET
CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE
Category
Description
Color Code
1
Elderberry bushes common to abundant, clumps of bushes commonly present, typically ranging in abundance from ≥ 5 to many bushes per acre.
2
Elderberry bushes common to infrequent, ranging from ≥ 1 bush per acre to 5 or more per acre.
3
Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered, often single bushes typically ≤ 1 bush per acre.
American River Watershed Investigation
U. S. Fish and Wildlife Service
Elderberry Distribution
Natomas Area
Map SAC RIV #5



CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE

Category	Description	Color Code
1	Elderberry bushes common to abundant, clumps of bushes commonly present, typically ranging in abundance from ≥ 5 to many bushes per acre.	
2	Elderberry bushes common to infrequent, ranging from ≥ 1 bush per acre to 5 or more per acre.	
3	Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered, often single bushes typically ≤ 1 bush per acre.	

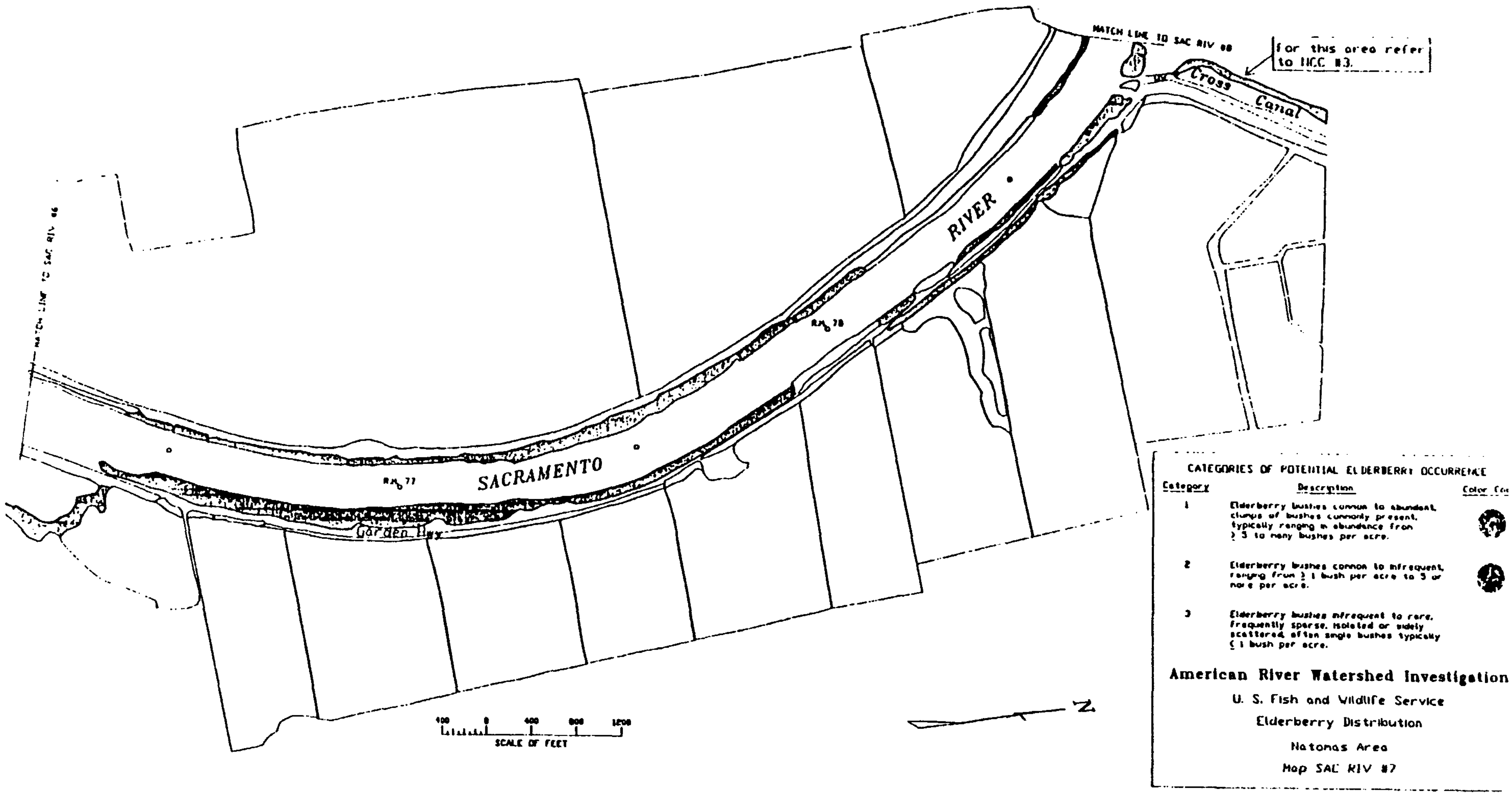
American River Watershed Investigation

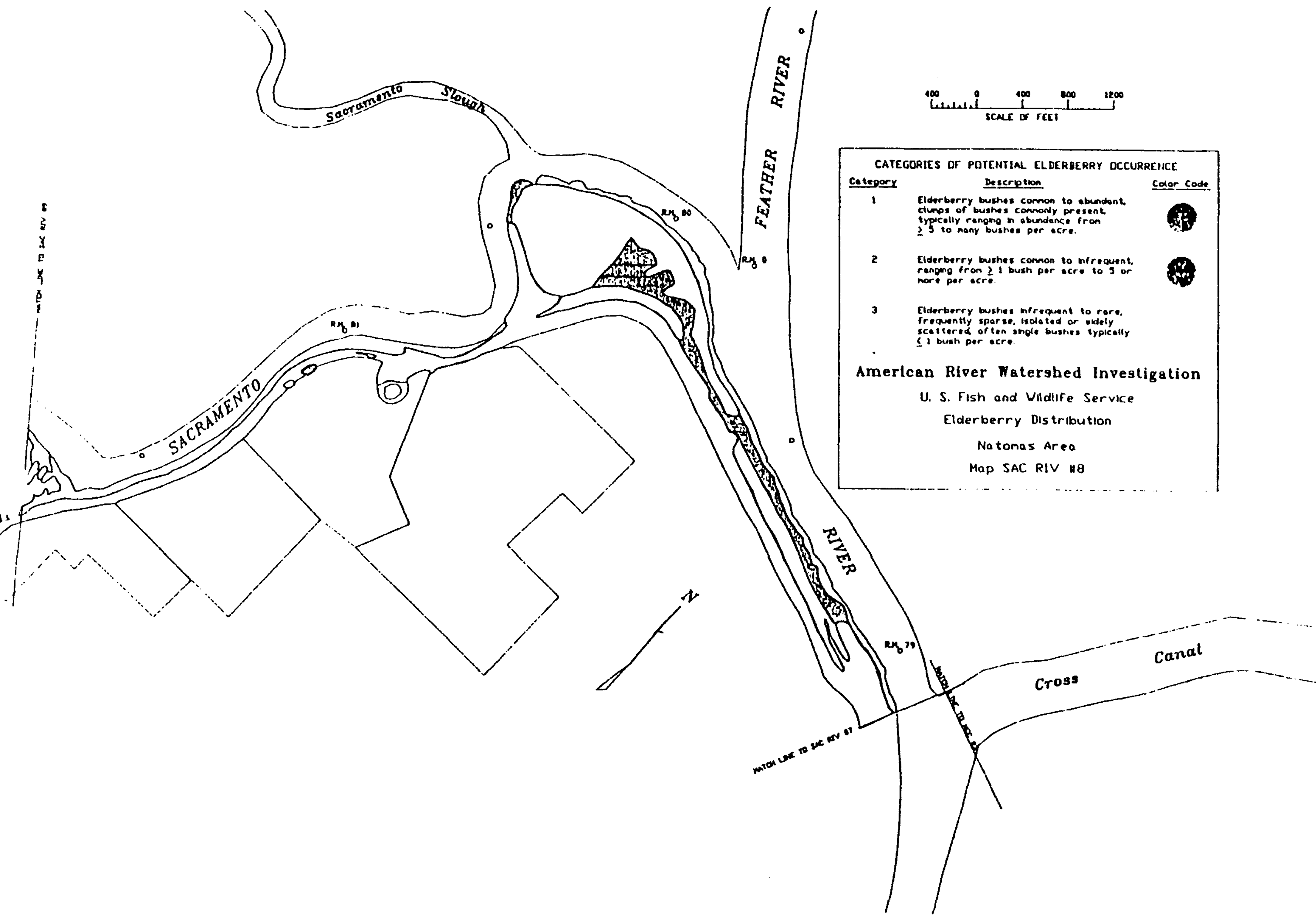
U. S. Fish and Wildlife Service

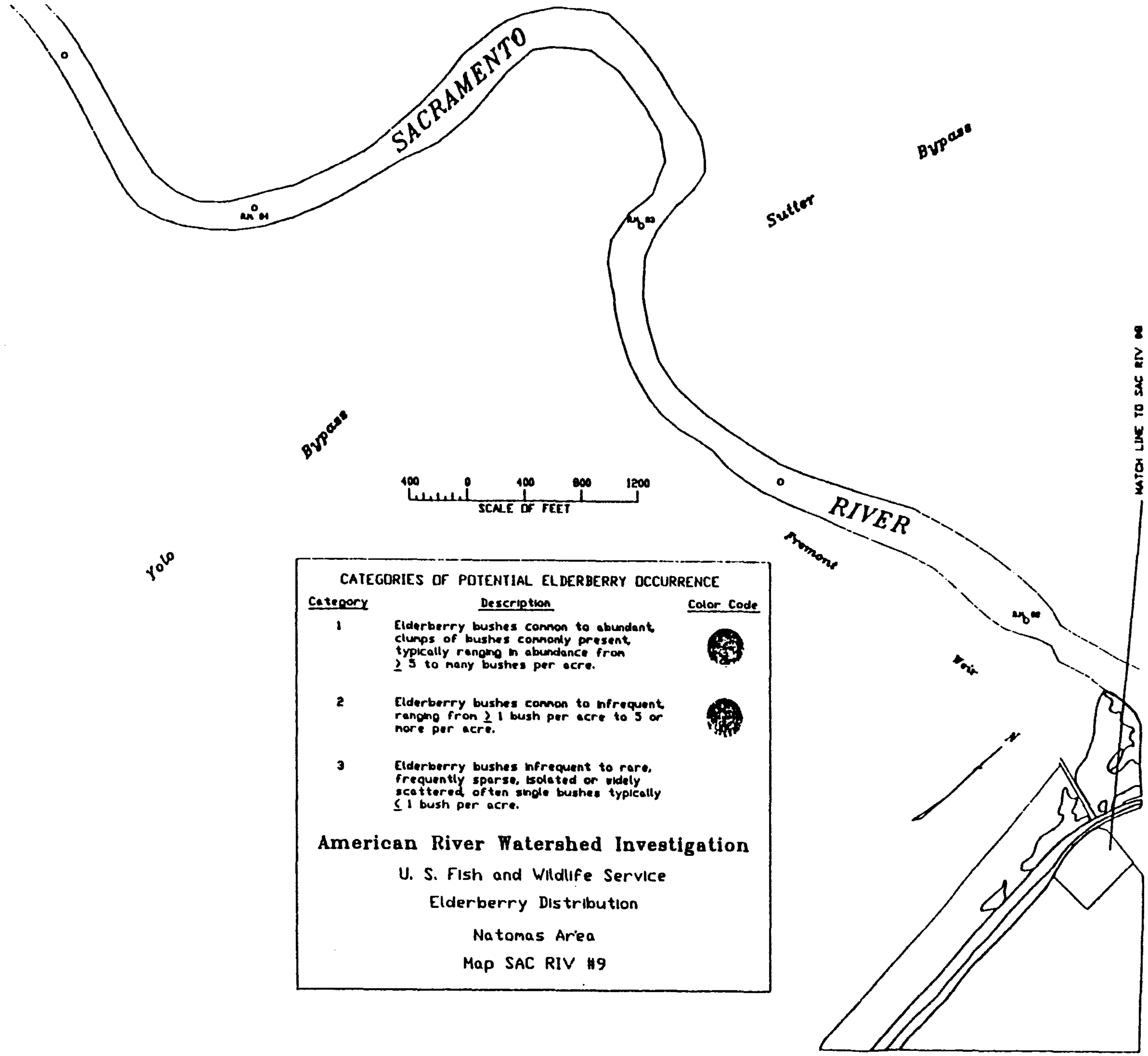
Elderberry Distribution

Natomas Area

Map SAC RIV #6


MATCH LINE TO SAC RIV #8
For this area refer to NCC #3.
Cross Canal
RIVER
SACRAMENTO
R.M. 78
R.M. 77
Garden Hwy
N
SCALE OF FEET
400 0 400 800 1200
CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE
Category
Description
Color Co
1
Elderberry bushes common to abundant, clumps of bushes commonly present, typically ranging in abundance from ≥ 5 to many bushes per acre.
2
Elderberry bushes common to infrequent, ranging from ≥ 1 bush per acre to 5 or more per acre.
3
Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered, often single bushes typically ≤ 1 bush per acre.
American River Watershed Investigation
U. S. Fish and Wildlife Service
Elderberry Distribution
Natomas Area
Map SAC RIV #7


Sacramento Slough
SACRAMENTO
FEATHER RIVER
RIVER
Cross Canal
R.M. 81
R.M. 80
R.M. 79
R.M. 0
MATCH LINE TO SAC RIV 87
N
400 0 400 800 1200
SCALE OF FEET
CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE
Category
Description
Color Code
1
Elderberry bushes common to abundant, clumps of bushes commonly present, typically ranging in abundance from ≥ 5 to many bushes per acre.
2
Elderberry bushes common to infrequent, ranging from ≥ 1 bush per acre to 5 or more per acre.
3
Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered, often single bushes typically ≤ 1 bush per acre.
American River Watershed Investigation
U. S. Fish and Wildlife Service
Elderberry Distribution
Natomas Area
Map SAC RIV #8



CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE

Category	Description	Color Code
1	Elderberry bushes common to abundant, clumps of bushes commonly present, typically ranging in abundance from ≥ 5 to many bushes per acre.	●
2	Elderberry bushes common to infrequent, ranging from ≥ 1 bush per acre to 5 or more per acre.	●
3	Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered, often single bushes typically ≤ 1 bush per acre.	

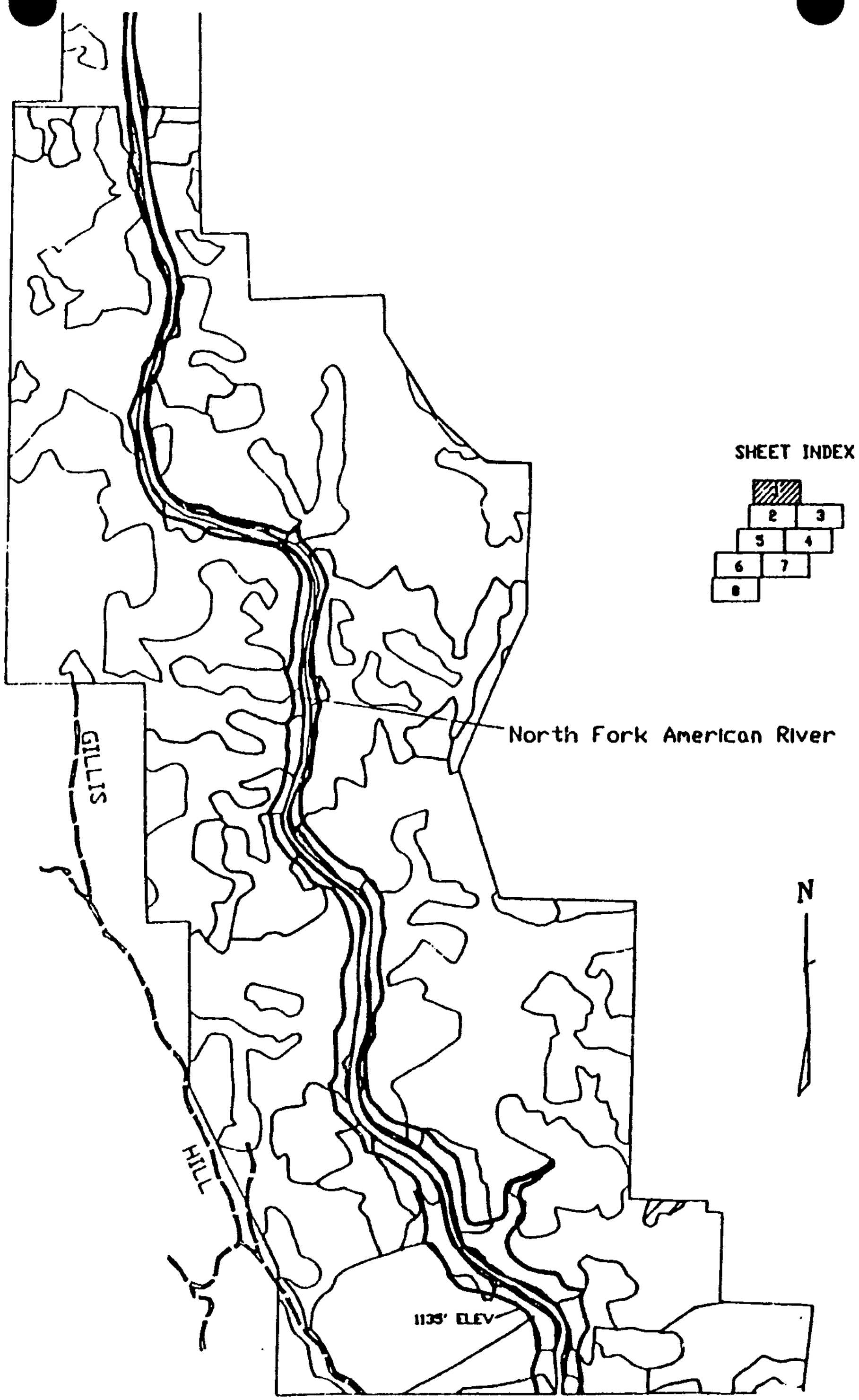
American River Watershed Investigation

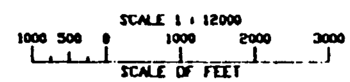
U. S. Fish and Wildlife Service

Elderberry Distribution

Natomas Area

Map SAC RIV #9





CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE

Category	Description	Color Code
1	Elderberry bushes common to abundant, clumps of bushes commonly present, typically ranging in abundance from ≥ 5 to many bushes per acre.	
2	Elderberry bushes common to infrequent, ranging from ≥ 1 bush per acre to 5 or more per acre.	
3	Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered, often single bushes typically ≤ 1 bush per acre.	

American River Watershed Investigation

U. S. Fish and Wildlife Service

Elderberry Distribution

Auburn Reservoir Area

Map # 1 of 8

CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE

Category	Description	Color Code
1	Elderberry bushes common to abundant, clumps of bushes commonly present, typically ranging in abundance from ≥ 5 to many bushes per acre.	
2	Elderberry bushes common to infrequent, ranging from ≥ 1 bush per acre to 5 or more per acre.	
3	Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered, often single bushes typically ≤ 1 bush per acre.	

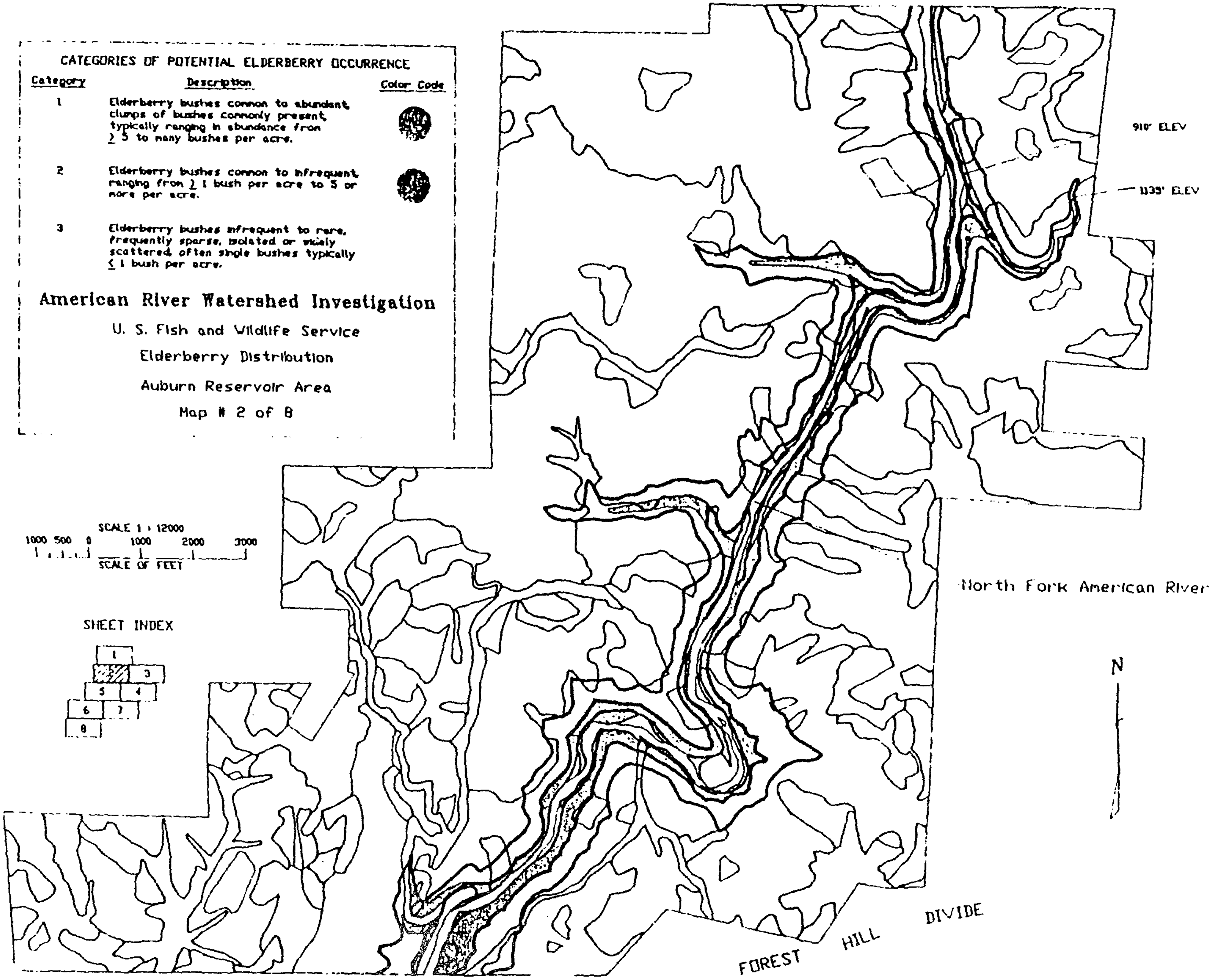
American River Watershed Investigation

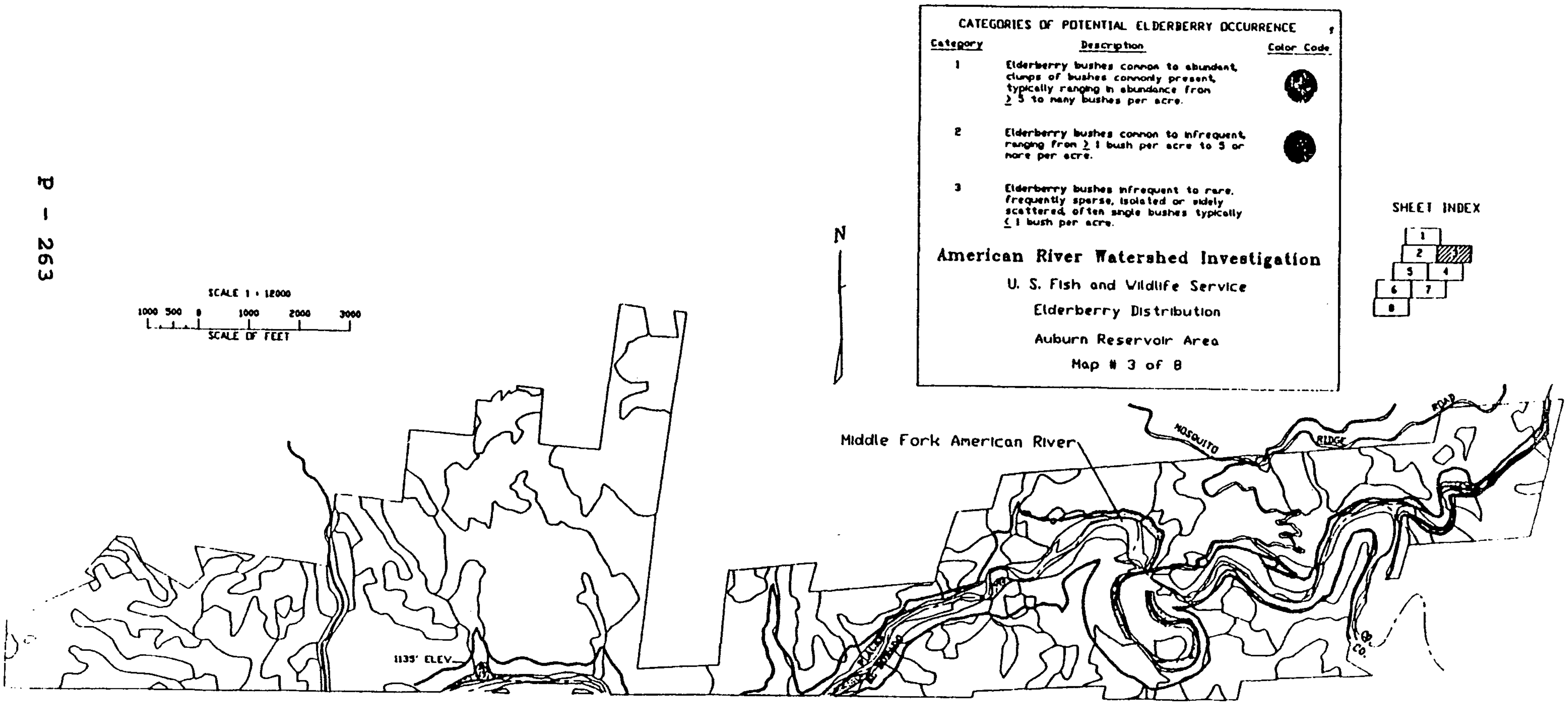
U. S. Fish and Wildlife Service

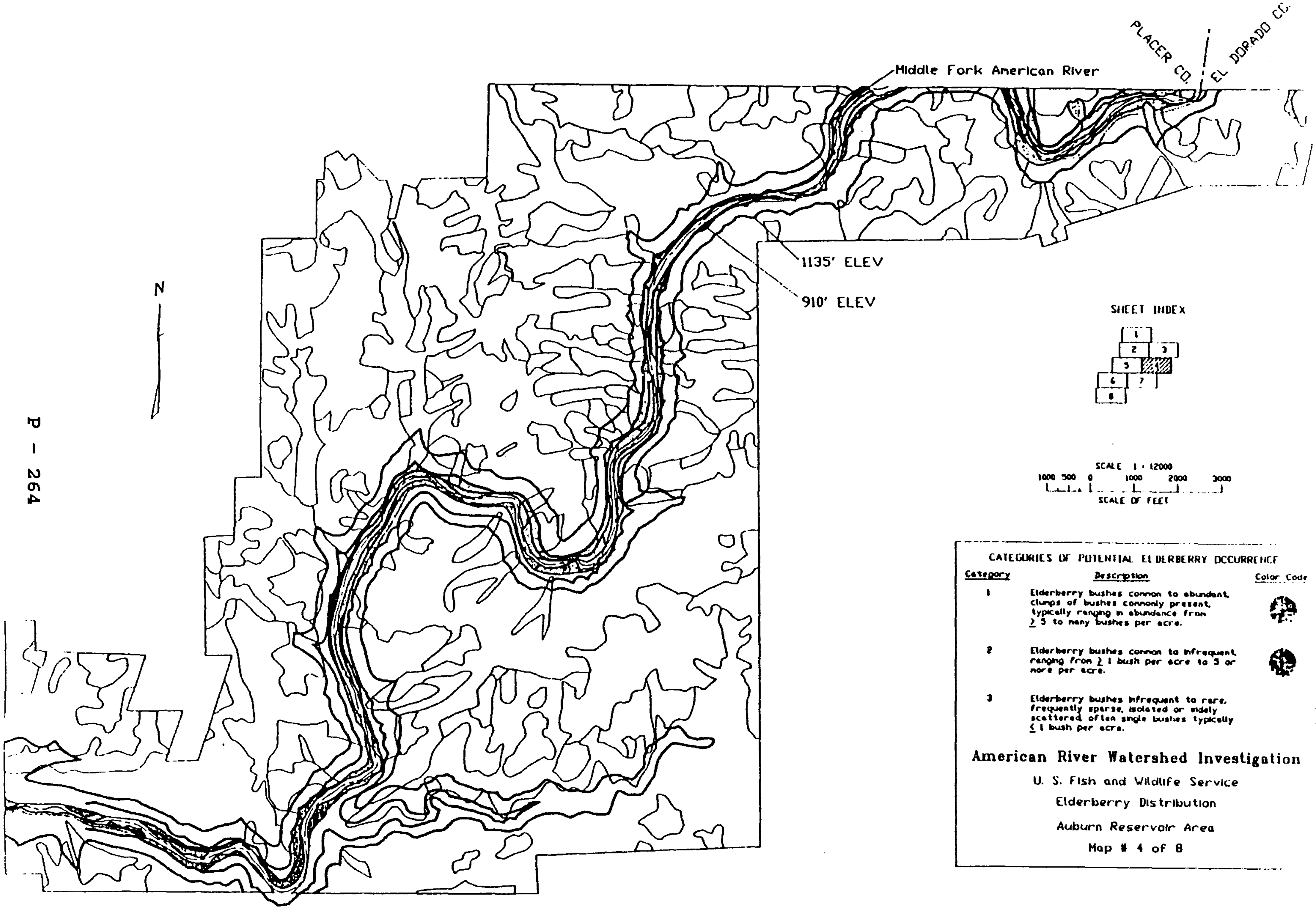
Elderberry Distribution

Auburn Reservoir Area

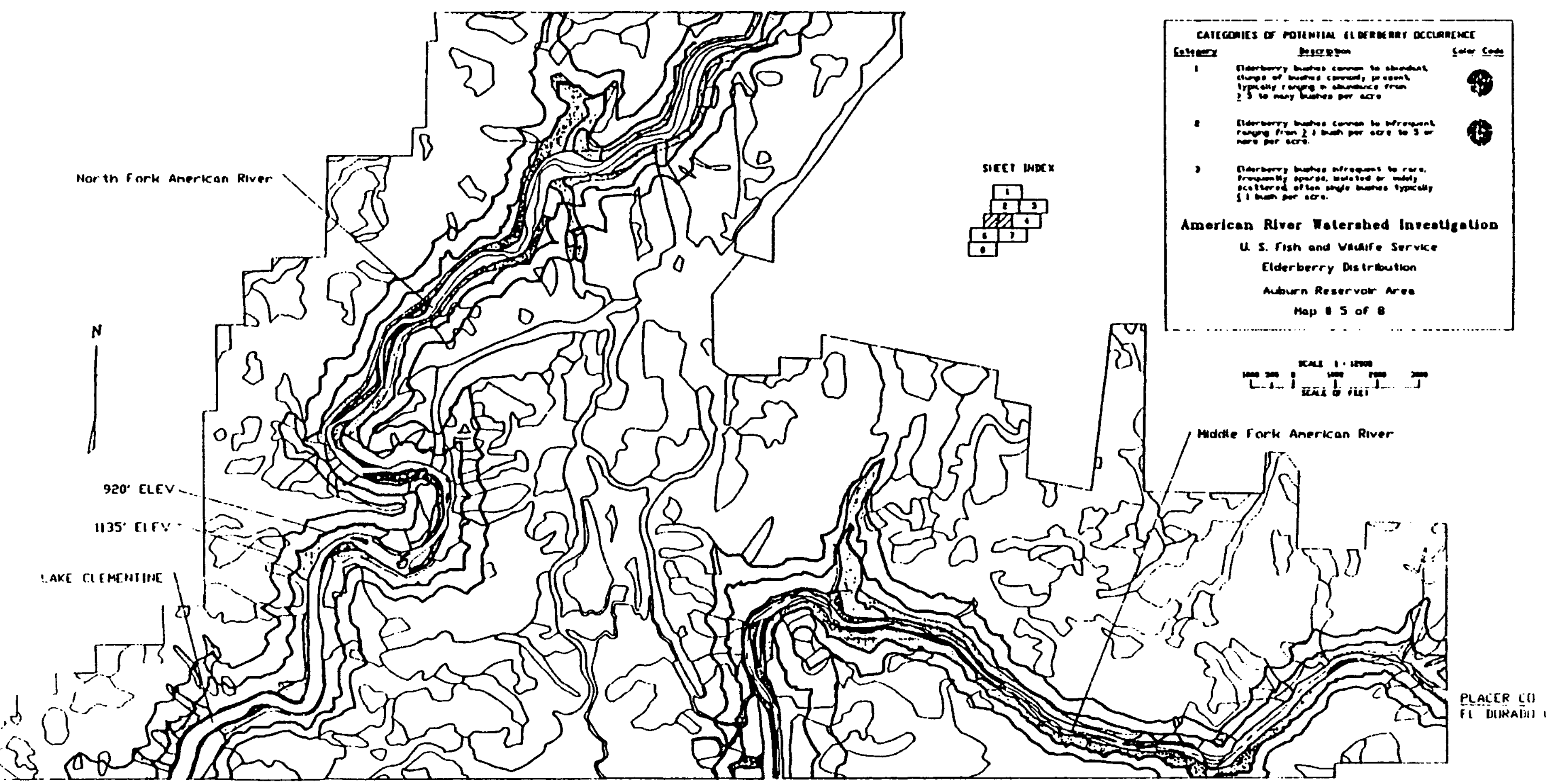
Map # 2 of 8




CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE
Category
Description
Color Code
1
Elderberry bushes common to abundant, clumps of bushes commonly present, typically ranging in abundance from ≥ 5 to many bushes per acre.
2
Elderberry bushes common to infrequent, ranging from ≥ 1 bush per acre to 5 or more per acre.
3
Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered, often single bushes typically ≤ 1 bush per acre.
American River Watershed Investigation
U. S. Fish and Wildlife Service
Elderberry Distribution
Auburn Reservoir Area
Map # 3 of 8
SHEET INDEX
1
2
3
4
5
6
7
8
N
SCALE 1 : 12000
1000 500 0 1000 2000 3000
SCALE OF FEET
Middle Fork American River
MOSQUITO
RIDGE
ROAD
1135' ELEV.



PLACER CO.
EL DORADO CO.
Middle Fork American River
1135' ELEV
910' ELEV
N
SHEET INDEX
1
2
3
5
6
7
8
SCALE 1 : 12000
1000 500 0 1000 2000 3000
SCALE OF FEET
CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE
Category
Description
Color Code
1
Elderberry bushes common to abundant, clumps of bushes commonly present, typically ranging in abundance from ≥ 5 to many bushes per acre.
2
Elderberry bushes common to infrequent, ranging from ≥ 1 bush per acre to 5 or more per acre.
3
Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered often single bushes typically ≤ 1 bush per acre.
American River Watershed Investigation
U. S. Fish and Wildlife Service
Elderberry Distribution
Auburn Reservoir Area
Map # 4 of 8



CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE
Category
Description
Color Code
1
Elderberry bushes common to abundant, clumps of bushes commonly present, typically ranging in abundance from ≥ 5 to many bushes per acre
2
Elderberry bushes common to infrequent ranging from ≥ 1 bush per acre to 5 or more per acre.
3
Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered often single bushes typically ≤ 1 bush per acre.
American River Watershed Investigation
U. S. Fish and Wildlife Service
Elderberry Distribution
Auburn Reservoir Area
Map # 5 of 8
SHEET INDEX
1
2
3
4
6
7
8
SCALE 1 : 12000
SCALE OF FEET
North Fork American River
Middle Fork American River
N
920' ELEV
1135' ELEV
LAKE CLEMENTINE
PLACER CO

CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE

Category	Description	Color Code
	Elderberry bushes common to abundant, clumps of bushes commonly present, typically ranging in abundance from ≥ 3 to many bushes per acre	
	Elderberry bushes common to infrequent, ranging from ≥ 1 bush per acre to 3 or more per acre	
	Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered, often single bushes typically < 1 bush per acre.	

American River Watershed Investigation

U. S. Fish and Wildlife Service

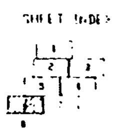
Elderberry Distribution

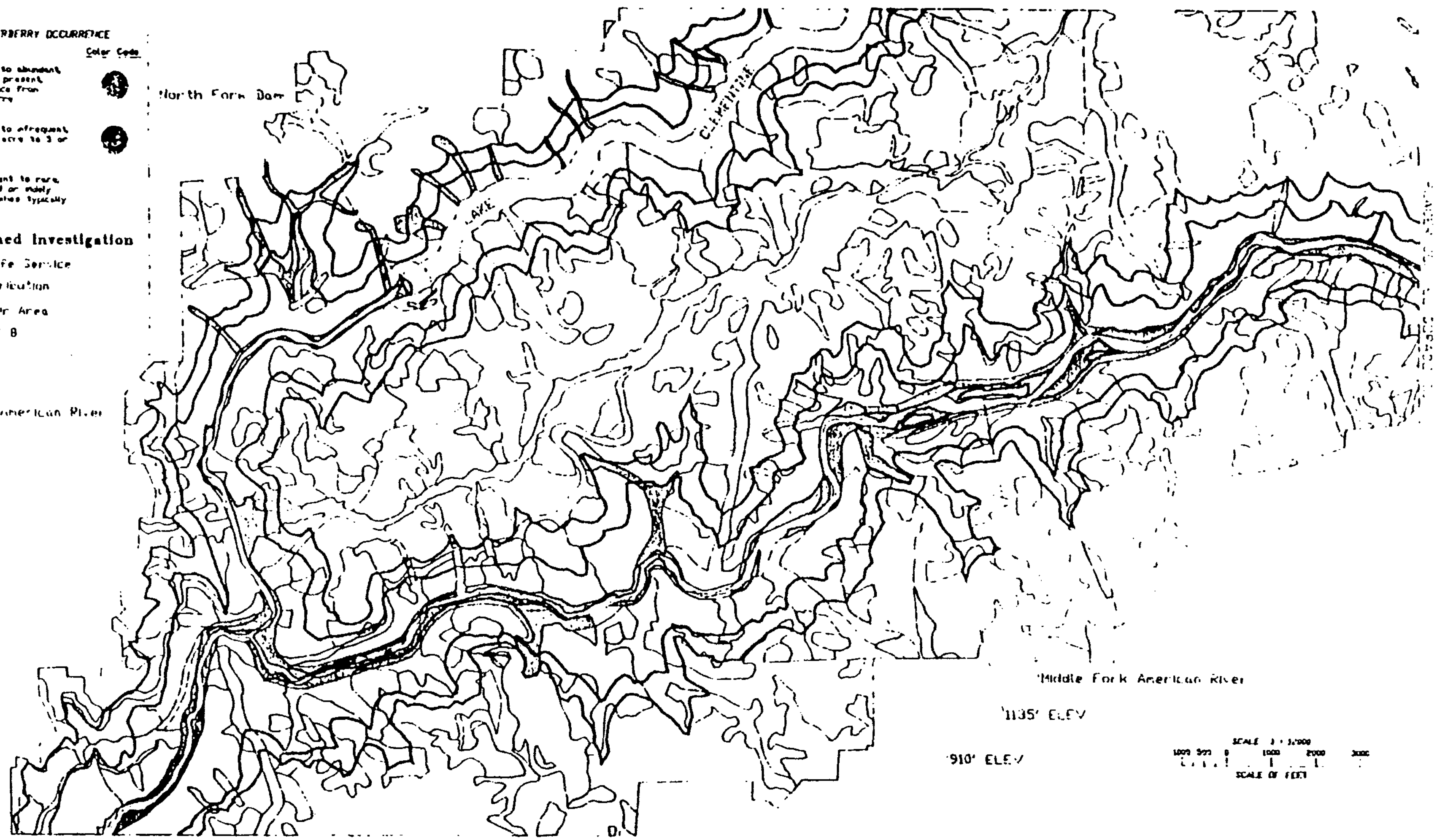
Auburn Reservoir Area

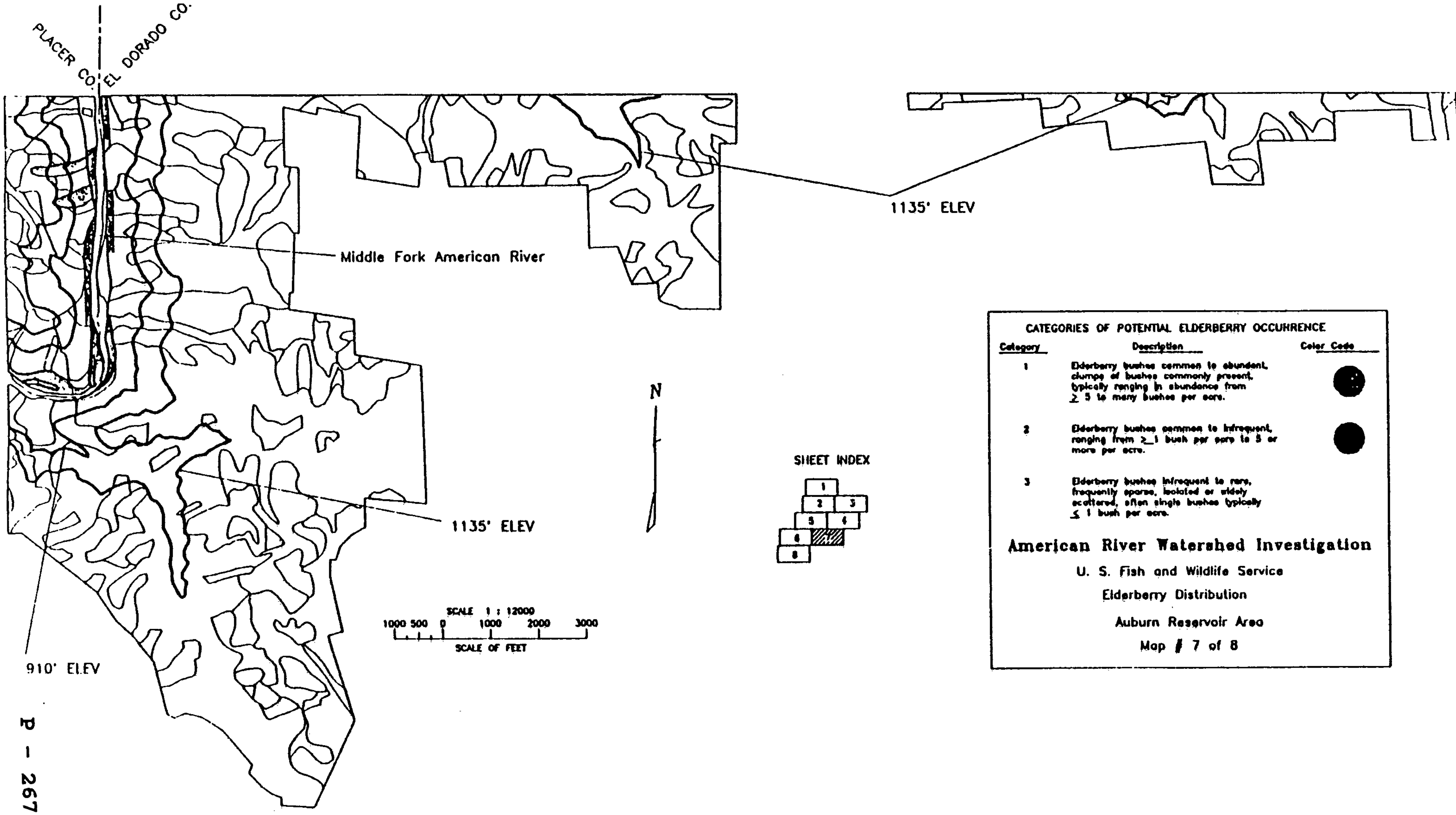
Map # 5 of 8

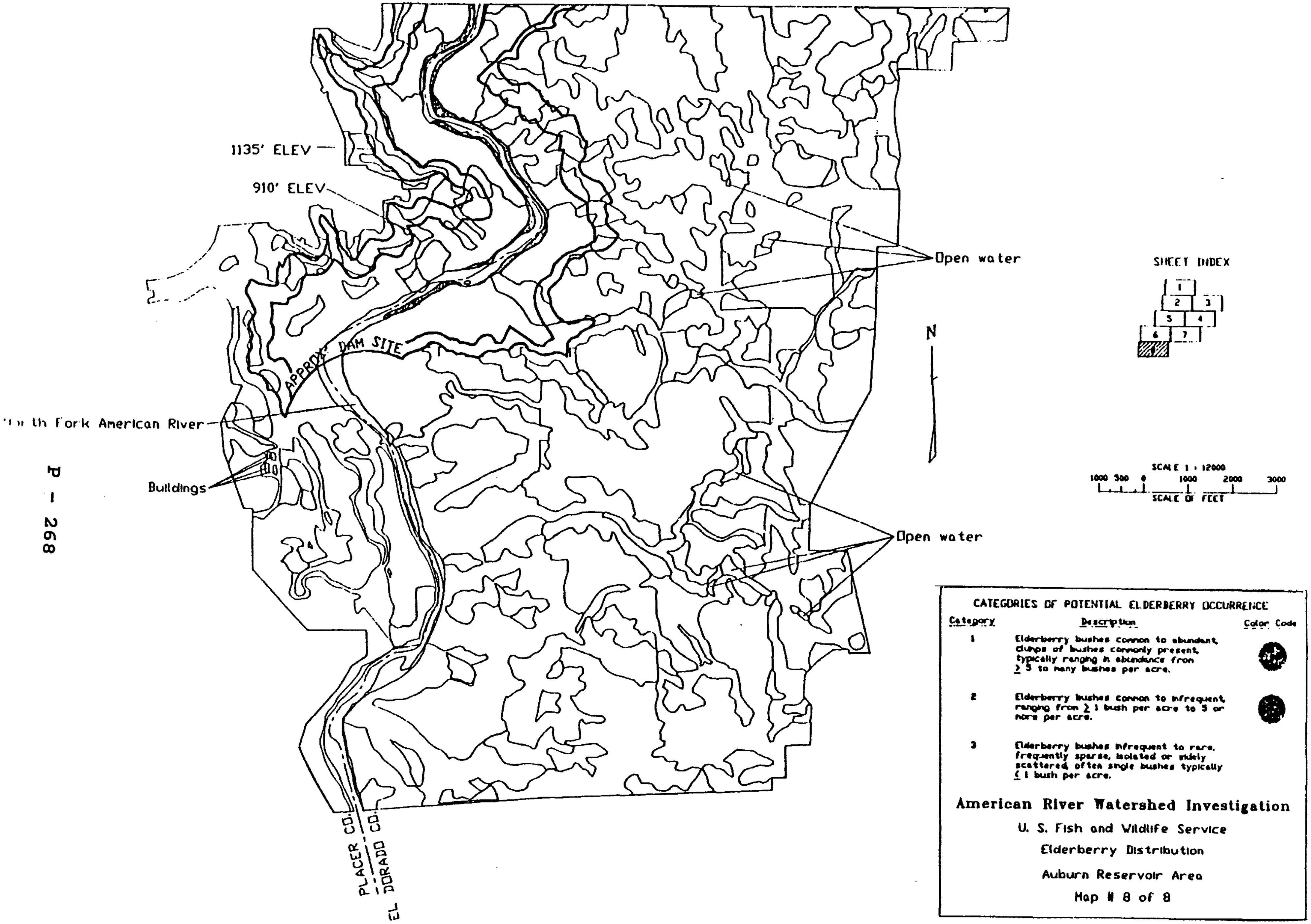
North Fork American River

SHEET INDEX






PLACER CO.
EL DORADO CO.
Middle Fork American River
1135' ELEV
1135' ELEV
910' ELEV
N
SCALE 1 : 12000
1000 500 0 1000 2000 3000
SCALE OF FEET
SHEET INDEX
1
2
3
5
4
6
8
CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE
Category
Description
Color Code
1
Elderberry bushes common to abundant, clumps of bushes commonly present, typically ranging in abundance from ≥ 5 to many bushes per acre.
2
Elderberry bushes common to infrequent, ranging from ≥ 1 bush per acre to 5 or more per acre.
3
Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered, often single bushes typically ≤ 1 bush per acre.
American River Watershed Investigation
U. S. Fish and Wildlife Service
Elderberry Distribution
Auburn Reservoir Area
Map # 7 of 8


1135' ELEV
910' ELEV
Open water
Open water
SHEET INDEX
1
2
3
5
4
6
7
N
SCALE 1 : 12000
1000 500 0 1000 2000 3000
SCALE OF FEET
APPROX. DAM SITE
North Fork American River
Buildings
PLACER CO.
EL DORADO CO.
CATEGORIES OF POTENTIAL ELDERBERRY OCCURRENCE
Category
Description
Color Code
1
Elderberry bushes common to abundant, clumps of bushes commonly present, typically ranging in abundance from ≥ 5 to many bushes per acre.
2
Elderberry bushes common to infrequent, ranging from ≥ 1 bush per acre to 5 or more per acre.
3
Elderberry bushes infrequent to rare, frequently sparse, isolated or widely scattered, often single bushes typically ≤ 1 bush per acre.
American River Watershed Investigation
U. S. Fish and Wildlife Service
Elderberry Distribution
Auburn Reservoir Area
Map # 8 of 8

American River Watershed Investigation, California

APPENDIX Q

Inundation Impact Analysis

FUGRO-McCLELLAND (WEST), INC.

FUGRO McClelland

Analysis of Potential Vegetation Mortality Resulting From Operation of the Proposed Auburn Flood Control Dam

By Fugro-McClelland
and
Andrew T. Leiser, Ph.D.

submitted to

State of California
Department of Water Resources
the Reclamation Board

December 1991

ANALYSIS OF POTENTIAL VEGETATION MORTALITY RESULTING FROM OPERATION OF THE PROPOSED AUBURN FLOOD CONTROL DAM

by
Fugro-McClelland (West), Inc.
and
Andrew T. Leiser, Ph.D.

Submitted to
State of California
Department of Water Resources
The Reclamation Board

December 1991

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1.0 INTRODUCTION

The construction of the proposed flood control dam at the Auburn site would periodically inundate portions of the North and Middle Forks of the American River to a maximum elevation of approximately 880 feet, mean sea level (msl) during a 200-year storm event. Inundation at lower elevations would occur more frequently for less severe storm events. As a consequence of periodic flooding, vegetation within the canyon will be subjected to inundation and, in some cases, total submergence for varying durations depending on elevation. In order to evaluate the potential impact of temporary inundation on the various vegetative cover types in the canyons, an analysis of potential flood impacts on canyon vegetation was conducted by Fugro-McClelland (West), Inc., in cooperation with Dr. Andrew T. Leiser, under contract to the California Department of Water Resources.

2.0 METHODS

Several methods were examined as possible means to evaluate impacts. Pilot-scale studies involving controlled laboratory and/or field experiments were considered to yield the most reliable data concerning inundation mortality; however, time and cost constraints precluded this technique.

A second approach considered was analysis of the amount of dead vegetation above and below inundation zones of sites subjected to variable flooding and exhibiting vegetation similar to those at the Auburn site. A statistically significant difference between sites could possibly infer flood-induced impacts. Differential mortalities among sites along an elevation gradient could then be compared to known elevations of flood events to suggest a relative tolerance level for species within each elevation band. However, this method was determined to be of low reliability for two reasons. First, no mortality from previous inundation events was observed within the American River canyon, below Keswick Dam, or along the lower American River. Second, lack of baseline data and controls would confound identification of a cause and effect relationship between flooding mortality and mortality from other causes, such as senescence, pathogens, disturbance, and particularly drought.

In light of these experimental constraints, the analytical approach used included seven strategies:

1) *a review of pertinent literature concerning inundation mortality was conducted to identify any generic studies which could potentially be applied to the proposed project;*

2) *an examination of vegetation communities within the American River canyon was conducted to search for signs of mortality potentially attributable to inundation resulting from operation of the former construction cofferdam;*

3) *a search for evidence of inundation mortality at other periodically flooded sites with similar vegetative cover was conducted to provide analog data;*

4) *personal observations and professional judgement based on previous experience in conducting flood tolerance studies on the Sacramento River and California reservoirs, and research plantings in an artificial flood basin at the University of California at Davis and at Folsom Lake (Harris, Leiser and Chan 1969; Harris, Leiser and Fissel 1975) were used to supplement literature reviews and site inspections;*

5) *a review of slope stability studies was used to analyze the potential vegetative loss due to slope failure;*

6) *a photographic comparison of early (1850's) and recent (1970's) vegetation patterns in the project area was performed to assist in determining successional patterns;*

7) *review of literature on successional theories and regeneration patterns of some representative species of the project area was conducted.*

In the absence of reliable on-site data from controlled studies, this approach was selected because it offered the most reliable means in determining probable impacts. These techniques are in common use and are the techniques for environmental assessment studies recommended by the National Academy of Sciences (Orians 1986).

The flood tolerance information derived from the seven analytical methods was then applied to the most credible inundation scenarios likely to occur within the 100-year period of analysis to estimate vegetation losses and soil stability as a function of flood event, elevation band, and cover type. Six areas of uncertainty were identified during the analysis. These were: lack of empirical data from controlled field and/or laboratory studies for some species; flood recurrence probabilities; timing of the onset of the growing season for certain species; age and vigor of individuals; ecotypic and genetic variation among and between species; and the potential vegetative loss from slope failure. Finally, a conceptual mitigation framework was formulated to provide a two-phase mechanism to mitigate for predicted impacts, as well as any impacts beyond those predicted.

3.0 BACKGROUND

The initial version of the inundation report was prepared in October 1990. In that report, mortality estimates were predicated on the assumption that the flood control dam would have the capacity to regulate a 400-year flood event using the existing ungated diversion tunnel at the project site. In November of 1990, the dam design was revised to include eight flood control sluices capable of discharging a maximum of approximately 70,000 cfs, and the closure of the diversion tunnel through construction of a bulkhead. Inclusion of the sluices was based on the need to provide a safety mechanism to evacuate the reservoir in the event the dam began to fail. The ability to evacuate flows with sluice gates would permit regulated discharges downstream into Folsom Reservoir rather than catastrophic releases from dam failure that would imperil the integrity of Folsom Dam and the lower American River levee system. The first revision, dated March 1991, was included in the draft Environmental Impact Statement/Report (DEIS/R) for the American River Watershed Investigation (Appendix Q). Based on comments received in response to the DEIS/R, the dam design was again revised to decrease the level of flood protection to a 200-year event. In addition, also based on comments received in response to the DEIS/R, the California Department of Water Resources (DWR) initiated two studies. The first study involved the examination of flood control reservoirs in Southern California for the purpose of determining impacts of periodic inundation on chaparral vegetation (Cummings 1991a). The second study was an evaluation of soil stability at the proposed dam site associated with the periodic flooding of the canyon (Dudley 1991).

This second revision of the inundation report is based on the new dam design and corresponding duration of flood events, and incorporates the findings of the new information provided by the Department of Water Resources, additional literature reviews, and historic photographs.

4.0 REVIEW OF LITERATURE

A review of literature, gathered through both library research and computer database queries (Dialog and Cambridge Scientific), was conducted to obtain any pertinent and credible scientific information concerning flood tolerance of vegetation. These data were supplemented with the literature file used in the

preparation of the flood tolerance study prepared by Whitlow and Harris (1979). The literature pertaining to the effects of flooding is generally focused on growing season impacts, and most studies are based on observations of bottomland hardwoods in the midwest and the southeast. The few notable exceptions are the field observations and research findings of growing season tolerances of native and introduced woody plants in California, which summarized observations of flooding along the lower Sacramento River (Harris, Leiser, and Fissel 1975), and at recreation reservoirs in California (Harris, Leiser, and Fong 1969); and, flood tolerance studies from woody species of the Mediterranean Region of California, the Rocky Mountains, the Pacific Northwest, and the arid and semi-arid regions of the western United States (Chapman et al. 1982; Walters et al. 1980a,b). These were the principal studies used in this report to identify flood tolerances of the woody species within the project area.

Literature concerning dormant season flooding is non-existent for California. Because information concerning certain species in the area is lacking, a degree of uncertainty is introduced into the analysis. The relevance of this unavailable information to this analysis is that certain species may be less tolerant than the 7-day non-growing season threshold standard used in this analysis and could, therefore, result in greater mortality for some species.

The literature concerning potential regeneration and succession patterns was based on several sources including Kozlowski et al. (1991), Fowells (1965), and Holling (1978).

4.1 Physiological Effects of Flooding. Authorities are in general agreement that mortality of woody plants due to flooding is minimal to non-existent if the flooding occurs during the dormant season. Inundation for short periods (less than 7-10 days) at the beginning of the growing season is usually not detrimental and is often beneficial. The beneficial effects are due to recharging soil water to a greater depth than by rainfall alone, with the consequent plant responses, including increased growth of established plants, increased survival of young seedlings, increased seed germination, and increased flower bud set for future seed crops. Moderate soil movement can increase dispersion and light burial of seed which can also increase the number of new seedlings.

Detrimental impacts to vegetation flooded during the growing season are strongly related to the timing and duration of such flooding. These effects are detailed extensively in the literature (Kozlowski 1984; Chapman et al. 1982; Walters et al. 1980a,b; Whitlow and Harris 1979; Teskey and Hinckley 1977; and Loucks 1970).

A number of factors have been identified as important contributors to the mortality of woody vegetation under flooded conditions. Many of these are chemical reactions or biological phenomena which are temperature-dependent and, therefore, only occur when soil temperatures are above certain minima. Much of the injury to plants during flooding is attributed to the reduction of oxygen in the soil and the effect of this reduction on both chemical and biological processes. Active roots require oxygen for respiration, and in the absence of oxygen, carbon dioxide accumulates. Oxides of iron, manganese, and other metals are chemically reduced under anaerobic conditions and can become toxic to plants. Nitrate in the soil can be chemically reduced and lost, and the breakdown of proteins in soil organic matter can produce toxic levels of ammonium ion. The normal conversions of ammonium ion to nitrate ion is blocked under anaerobic conditions. This process -- protein to ammonium ion to nitrate ion -- is accomplished by fungi and bacteria. These chemical and biological processes are slower or blocked at lower temperatures and accelerated at higher temperatures. For many of the biological processes, 40°F is a critical temperature (Brady 1974). Flooding when soil temperatures are below 40°F is less apt to have detrimental effects on these processes and, therefore on the vegetation, than flooding when soil temperatures are higher. Comprehensive discussions of these interrelationships can be found in Kozlowski et al. (1991), Kozlowski (1984), Whitlow and Harris (1979), and Brady (1974).

Soil temperatures vary by depth through the year. The upper six inches is usually warmer than the air temperature at every season of the year. Subsoil temperature is usually warmer than air temperature in winter and cooler than the air temperature in the summer. Changes in subsoil temperatures lag behind the changes in air temperatures. In temperate climates, the temperature of the soil between 12 and 36 inches deep (where the majority of roots of woody plants are located) is usually below 40°F from late October-early November until late February-early April. Actual dates vary with soil type, aspect, soil cover, air temperature and other factors (Brady 1974). Generally during this period, there will be little root growth or activity in most woody plants. Spring warming of soils is delayed on north-facing slopes, under heavy vegetation canopy or mulch, in wet soils, and/or where nights are colder than normal.

Kozlowski (1984) cites studies by Coutts (1982) that demonstrated a higher flooding tolerance in woody roots than in non-woody roots. In tree and shrub species, non-woody roots are generally found during periods of active root growth. As plants enter dormancy, non-woody roots either become woody roots or die off after functioning as annual roots. Consequently, less root damage is expected during dormant season flooding than during growing season flooding.

4.2 Growing Season. Based on flood frequency data developed by the U.S. Army Corps of Engineers, flooding of the American River resulting from operation of the proposed flood control dam would occur principally during the winter months (December-March) when most vegetation would be dormant. Appendix A includes information pertaining to flood elevation, duration and exceedence frequencies, by month, for a 200-year dam at the Auburn site.

For the Auburn area, the 50 percent probability level for the frost-free period is between March 3 and December 1, based on records between 1951-1980 (Koss et al. 1988). This 273-day growing season increases to 322 days at 10 percent probability level, and decreases to 224 days at 90 percent probability level. These data are consistent with those reported by Hambidge (1941). Conditions in the American River canyon will differ somewhat because of cold air drainage. On average, the last killing frost in the canyon will be later than for the City of Auburn (Veerkemp, pers. comm. 1990).

Flooding during the growing season is much more detrimental to woody plants than flooding during the dormant season, as noted in Section 4.1. "Growing season", as used in all the literature on flood tolerance and in this report, is defined as that period from the swelling of vegetative buds, through shoot elongation, to the setting of the resting buds for the next season's growth. It normally extends through late summer, ending when one or more of the following occur: leaf fall in deciduous species; growth cessation in evergreen species; and/or the first frost in fall. The growing season is also frequently defined as that period between the last killing frost in the spring and the first killing frost in the fall. "Dormant season" is used in the literature to describe that period beginning with the first fall frosts and the cessation of growth in woody plants, extending through the winter and ending with bud-break and the onset of shoot elongation and new leaf formation in the late winter or spring.

While cambial growth and photosynthesis can occur during the dormant season, none of the literature reviewed indicated that the occurrence of these activities during the dormant season altered the susceptibility of woody plants to damage from dormant season flooding. The studies summarized in the following paragraphs discuss the factors affecting these processes.

A number of the species in the American River canyon are associated with the chaparral community. This is of particular concern because many of the evergreen chaparral species have evolved a growth strategy adapted to summer drought/winter rain climate patterns, and can initiate growth in the late winter and spring when optimal soil moisture and air temperatures coincide. However, other foothill and chaparral species that inhabit more mesic sites, such as squawbush and hazelnut, adopt a more typical strategy of leaf drop and dormancy during the cool season (Bakker 1984). Those species which do initiate growth in the late

winter may be more susceptible to flooding impacts. This situation occasioned an examination of pertinent studies concerning phenology of chaparral taxa.

The range of cambial activity patterns of four species of southern California chaparral plants was studied by Avila et al. (1975). Activity occurred throughout the year in sugarbush (*Rhus ovata*), with the peak coinciding with the flush of vegetative growth in late February and early March. Cambial activity extended from December through mid-June with a peak during the active growth period of late January through April in toyon (*Heteromeles arbutifolia*). In two oak species studied, scrub oak (*Quercus dumosa*) and coast live oak (*Q. agrifolia*), cambial activity was restricted to the spring and early summer months with peaks occurring more or less during the middle of this period.

Photosynthetic activity can occur in evergreen plants at any time during the year when temperatures and water relations are not limiting. Hanes (1965) studied two species of *Adenostoma*, chamise (*A. fasiculatum*) and red shank (*A. sparsifolium*), which differ markedly in gross morphology and in the development of root systems. These studies conducted in coastal southern California involved the correlation of environmental factors with growth and reproduction from June 1962 to June 1963. Chamise shoot growth decreased markedly by July and essentially ceased by November, while red shank did not reach minimal growth levels until December. Both species began shoot elongation in mid-February. Photosynthesis determinations were made on well-watered plants growing in pots in the laboratory, and were recorded from mid-December through July. Seasonal maxima were attained in late January, with minima occurring in mid-July. Photosynthesis was strongly affected by temperature with a maximum rate for both species at 68°F. Rates for both species were about 20 to 40 percent less at 50°F and 86°F, respectively, and greatly reduced at 40°F.

Plant species may vary considerably in the dates that growth actually begins in the spring and ceases in the fall. Some species begin shoot growth before the last killing frost, some begin after this event. Aspect and the elevation differences between 500 and 900 feet will affect the time at which a given species breaks dormancy. An average date of mid-March is assumed for the beginning of the growing season in the American River canyon. Some taxa, such as western redbud (*Cercis occidentalis*) and manzanita (*Arctostaphylos spp.*), flower well before the growing season starts, but early flowering should not be confused with active vegetative growth. Summer drought causes many species, particularly certain chaparral species, to cease growth and enter dormancy.

The influence of soil moisture on photosynthesis was also examined by Hanes. Plants were grown in a sandy soil of 88.2 percent sand, 5.6 percent silt, and 6.2 percent clay. Water content was expressed as percent by dry soil weight. Photosynthesis of red shank was maximum at field capacity (23.8 percent water). Photosynthesis of chamise was maximum at just below field capacity at 20 percent soil water. Photosynthesis in soils approaching saturation was reduced somewhat, 77.7 percent of maximum at 89 percent water for chamise and 87.6 percent of maximum at 71 percent water for red shank. Photosynthesis decreased rapidly as soil moisture decreased below the maxima (i.e., photosynthesis at field capacity). At 15 percent soil water, photosynthesis in both species was below that of the nearly saturated soils (69 percent and 81 percent for chamise and red shank, respectively). At the wilting point (10 percent water), photosynthesis was 36 percent of maximum for chamise, and 53 percent of maximum for red shank, compared with 77.7 percent and 87.6 percent, respectively, for the near-saturation condition.

These data suggest that the increased soil water from flooding could increase the average net photosynthesis compared to that in soils below field capacity. Dormant season photosynthesis data could not be found for other chaparral species.

Miller (1947) conducted *in situ* studies of several chaparral species on paired sites on north and south exposures at 1,250- to 5,500-foot elevations in the San Gabriel Mountains in southern California.

Environmental factors examined included soil moisture at four depths, soil temperature, evaporation rates, and maximum, minimum, and mean air temperatures. He found that minimum air temperatures appeared to control the onset of growth in the spring, but that large air temperature fluctuations and higher insolation (hence, higher evapotranspiration rates) had a retarding influence on the inception of growth. The study was conducted over a three-year period and large differences in the growth patterns were observed within and among species and between years. Several species exhibited both periods of minimal growth activity (i.e. less than 1 cm of shoot growth per two-week interval) and periods of very active growth. The ranges of growth periods for commencement of minimal and rapid growth for the various sites are summarized in Table 1. Although elevations were higher in this study than found at the project site in the American River canyon, the southern California study sites were subject to ocean influences and were at more southerly latitudes.

TABLE 1.
COMMENCEMENT OF SHOOT GROWTH OF SEVERAL CHAPARRAL SPECIES IN THE SAN GABRIEL MOUNTAINS[1]

SPECIES	COMMENCEMENT OF GROWTH	
	MINIMAL GROWTH[2]	MAIN GROWTH FLUSH
Chamise *Adenostoma fasciculatum*	Early Feb - Late Apr	Mid-Mar - Early May
Eastwood manzanita *Arctostaphylos glandulosa*	Mid-Apr - Early Jun	Mid-Apr - Mid-Jun
Hoaryleaf ceanothus *Ceanothus crassifolius*	Mid-Jan - Early Apr	Early Mar - Mid-Apr
Chaparral whitethorn *C. divaricata*	Mid-Mar	Mid-Apr - Mid-May
Hairy ceanothus *C. oliganthus*	Mid-Jan - Early Apr	Early Mar - Mid-Apr
Western mountain-mahogany *Cercocarpis betuloides*	Early Mar - Early May	Early May - Mid-May
Canyon live oak *Quercus chrysolepis*	Mid-Feb - Early May	Early Apr - Late Apr
California scrub oak *Q. dumosa*	Early Feb - Late Apr	Mid-Apr - Early May
Interior live oak *Q. wislizenii*	Late Mar - Early Apr	Early Apr - Mid May
White sage *Salvia apiana*	Early Jan - Late Apr	Mid-Feb - Late Apr
Black sage *S. mellifera*	Early Jan	Mid-Late Feb

[1]Source: Miller (1947)
[2]Minimal growth defined at less than 1 cm of shoot growth/14 days

Baker et al. (1982) studied three chaparral species -- chamise (*Adenostoma fasciculatum*), whiteleaf manzanita (*Arctostaphylos viscida*), and buck brush (*Ceanothus cuneatus*) -- at two sites in Sequoia National Park. Observations at one site were for two seasons (1978 and 1979), and at the other site for one season (1978). The

commencement of growth within species varied between sites and at the one site, between years. Chamise began growth in mid-February at one site and in early March at the other site, and mid-February versus mid- to late-April between years. Shoot growth of manzanita varied from early to mid-April between sites and from mid-March to mid-April between years. Buck brush varied between early and mid-February between sites and between mid-February and early April between years.

These investigators reported that drought in 1976 and 1977 appeared to have had an adverse effect on flower bud set for manzanita, which forms flower buds on the previous season's growth. Increasing soil moisture from periodic flooding may potentially benefit certain chaparral species by increasing soil moisture.

In summary, these studies indicate that the onset of the growing season is variable in certain foothill and chaparral species and could occur during the time frame in which flooding is most likely (Dec-Feb). However, the onset of the main growth flush, even in evergreen foothill and chaparral species, generally occurs later in winter and early spring when flooding is less likely to occur.

4.3 Flood Tolerances of Typical Plants at Project Site. The flood tolerance of woody plants is generally determined by the number of consecutive days of inundation during the growing season that a species can withstand before dying. Table 2 provides a summary of the flood tolerance categories used by the U.S. Fish and Wildlife Service.

TABLE 2.
WOODY PLANT FLOOD TOLERANCE CRITERIA OF THE U.S. FISH AND WILDLIFE SERVICE[1]

TOLERANCE RATING	SURVIVAL THRESHOLD	DESCRIPTION
Very Tolerant (VT)	1-2 Years	Trees which can withstand flooding for periods of tow or more growing seasons. These species generally exhibit good adventitious or secondary root growth during this period.
Tolerant (T)	1 Year	Trees which can withstand flooding for most of one growing season. Some root development can be expected during this period.
Intermediately Tolerant (IT)	30-90 days	Species which are able to survive flooding for periods between one to three months during the growing season. The root systems of these plants may produce few new roots or will be dormant during the flooded period.
Intolerant (I)	<30 days	Species which cannot withstand flooding for short periods (1 month or less) during their growing season. The root systems die during this period.

[1]Sources: Chapman et al. (1982); Walters et al. (1980a,b)

A number of generic reports have been published listing the flood tolerance of various species (Chapman et al. 1982; Walters et al. 1980a,b; and Whitlow and Harris 1979), including many which inhabit the American River canyon in the vicinity of Auburn. The dominant woody species occupying the proposed inundation zone and reported growing-season flood tolerance thresholds are summarized in Table 3.

TABLE 3.
GROWING SEASON FLOOD TOLERANCES OF TYPICAL SPECIES FOUND AT THE INVESTIGATION SITES[1]

SPECIES	FLOOD TOLERANCE (Days of Inundation)	TOLERANCE RATING[1]	LOCATION[2]
OAK WOODLANDS			
California buckeye *(Aesculus californica)*	30-90	IT	1,2,3
Pacific madrone *(Arbutus menziesii)*	30-90	IT	1
Manzanita[3] *(Arctostaphylos spp.)*	30-90	IT	1,2,4
Saltbush *(Atriplex sp.)*	30-90+	IT	1
Ceanothus[4] *(Ceanothus spp.)*	ND[5]		1,2
Western Redbud[6] *(Cercis occidentalis)*	30-90	IT	1,2
California hazelnut[7] *(Corylus rostrata)*	ND		1
Shrub tan-oak[8] *(Lithocarpus densiflora)*	ND		1
Ponderosa pine[9] *(Pinus ponderosa)*	30-90	IT	1,2
Digger pine[10] *(P. sabiniana)*	ND		1,2
Douglas fir *(Pseudotsuga menziesii)*	30-90	IT	1
Canyon live oak[11] *(Quercus chrysolepis)*	ND		1
Black oak *(Q. kelloggii)*	>90		1
Valley oak[12] *(Q. lobata)*	30-90	IT	1,2
Interior live oak *(Q. wislizenii)*	30-90	IT	1,2,3
Coffeeberry[3,13] *(Rhamnus spp.)*	30-90	IT	1,2,3
Poison oak[14] *(Rhus diversiloba)*	ND		1,2,3
California bay[15] *(Umbellularia californica)*	30-90	IT	1
CONIFER FOREST			
Ponderosa pine *(Pinus ponderosa)*	30-90	IT	1,2
Digger pine *(P. sabiniana)*	ND		1,2
Douglas fir *(Pseudotsuga menziesii)*	30-90	IT	1
CHAPARRAL			
Chamise *(Adenostoma fasciculatum)*	ND		1,3
Manzanita *(Arctostaphylos spp.)*	30-90	IT	1,2
Ceanothus[16] *(Ceanothus spp.)*	ND		1,2
Western Mountain-mahogany[17] *(Cercocarpis betuloides)*	ND		1
Flannel bush[18] *(Fremontodendron californica)*	ND		1

TABLE 3. Continued

SPECIES	FLOOD TOLERANCE (Days of Inundation)	TOLERANCE RATING[1]	LOCATION[2]
CHAPARRAL (Continued)			
Toyon[19] *(Heteromeles arbutifolia)*	ND		1,2,3
Canyon live oak shrubs *(Quercus chrysolepis)*	ND		1
Blue oak shrubs *(Q. douglasii)*	>90	T	1,2
Interior live oak shrubs *(Q. wislizenii)*	30-90	IT	1,2,3
Snowberry *(Symphoricarpos sp.)*	30-90	IT	1
RIVERINE/RIPARIAN			
White alder *(Alnus rhombifolia)*	>90	VT	1,2,3
Western serviceberry *(Amelanchier alnifolia)*	30-90	IT	1
Mulefat *(Baccharis viminea)*	>90	T	1
Red-osier dogwood *(Cornus stolonifera)*	30-90	IT	1,2
Mountain dogwood *(C. nuttalli)*	>90	T	1,2
Oregon ash *(Fraxinus latifolia)*	>90	T	1
California black walnut *(Juglans hindsii)*	>90	T	1,2
Western sycamore *(Platanus racemosa)*	30-90	IT	1,2
Fremont cottonwood *(Populus fremontii)*	30-90	IT	1,2
Gooseberry *(Ribes spp.)*	>90	T	1,3
Elderberry *(Sambucus sp.)*	30-90	IT	1
Wild grape[20] *(Vitis californica)*	ND		1,2
Willows *(Salix spp.)*	30-90+	IT-T	1,2,3
Clematis *(Clematis ligusticifolia)*	30-90	IT	2
Boxelder *(Acer negundo californicum)*	>90	VT	2,3
Bigleaf maple *(Acer macrophyllum)*	30-90+	IT-T	1,2,3

Sources: Chapman et al. (1982), Walters et al. (1980)

[1] Tolerance Ratings derived from Chapman et al. (1982) and Walters (1980a,b):
VT = Very Tolerant;
T = Tolerant;
IT = Intermediately Tolerant;
I = Intolerant.

[2] Locations:
1 = American River Canyon;
2 = Keswick Dam;
3 = Lower American River;
4 = San Gabriel Mountain Dams.

TABLE 3. Continued

[3]Flood tolerances for manzanita and coffeeberry were based on congenerics, *Arctostaphylos nevadensis* and *Rhamnus betulaefolia*, respectively, and may not accurately reflect the tolerances of the species found at the site. At least two species commonly flooded at Keswick-Redding site. Several species in the American River canyon show no adverse effects of previous flooding events.

[4]*Ceanothus spp*. At least two species survive regular flooding at the Keswick-Redding site with no adverse effects. At least two species survive in excellent condition on the American River below 600 feet. No signs of damage or dieback.

[5]ND = No Data.

[6]*Cercis occidentalis*. Flooded at Keswick-Redding site.

[7]*Corylus rostrata*. Should read *Corylus cornuta var. californicus* (Syn.: *C. rostrata*). Occurs in damp places (Munz). Therefore, it is probably dormant-season flood tolerant.

[8]*Lithocarpus densiflora*. Probably rare. In cultivation it thrives with irrigation and is not water intolerant as are many chaparral species.

[9]*Pinus ponderosa*. Same comments as for *P. sabiniana* (Table 3).

[10]*Pinus sabiniana*. Occasional below 600 feet, common below 900 feet. Shows no evidence of flood damage (Table 3).

[11]*Quercus chrysolepis*. Common in the American River Canyon even down almost to water's edge. It has withstood dormant season flooding with no apparent ill effect. See Table 3.

[12]*Q. lobata*. Common in riparian forests. Large stand at Caswell State Park is regularly flooded.

[13]*Rhamnus californica var. tomentella*. Same comments as for *Q. chrysolepis*.

[14]*Rhus diversiloba*. Common at other locations in California that are subject to dormant flooding. Occasional in the American River Canyon below 650 feet and shows no detrimental effects of flooding.

[15]*Umbellularia californica*. Common in riparian woodlands in some areas. See Table 3.

[16]*Ceanothus spp.*. See note 4.

[17]*Cercocarpus betuloides*. Rare in the American River canyon below 600 feet but no evidence of damage from previous flood events were noted.

[18]*Fremontodendron californica*. Not seen on field trips. Rare, or not below 2,000 feet (Munz).

[19]*Heteromeles arbutifolia*. Common and thriving from 500 feet and higher in the American River Canyon.

[20]*Vitis californica*. Common California riparian forest species (Munz). Vigorous and thriving down to river's edge in the American River Canyon.

4.4 Occurrence of Foothill/Chaparral Species in Riparian Corridors. As indicated in Table 3, empirical data on the flood tolerance of several common species found in the upper American River canyon, such as manzanita (*Arctostaphylos spp.*) buck brush and other *Ceanothus* species, toyon, western redbud (*Cercis occidentalis*), digger pine (*Pinus sabiniana*), etc., are lacking. However, these species are sometimes found within riparian corridors subjected to periodic flooding. Therefore, a review of literature was conducted to identify examples of the occurrence and distribution of representative foothill and chaparral species in the Central Valley and other areas in California.

Riparian vegetation mapping studies conducted by Warner (1984) confirm occasional occurrences of typically foothill species along riparian corridors in the Central Valley. Upland species recorded during the sampling of 51 riparian sites included digger pine, manzanita, interior live oak (*Quercus wislizenii*), black oak (*Q. kelloggii*), toyon, California buckeye (*Aesculus californica*), and ponderosa pine (*Pinus ponderosa*). Roberts et al. (1977) categorized interior live oak, California buckeye, and toyon as "uncommon" trees/shrubs of the Central Valley Riparian Forest.

Laymon (1984) noted that the predominant vegetation along Brewer Creek near Red Bluff, California consisted of scattered cottonwoods, but the understory was composed of much less typical riparian species, including live oaks, blue oaks, toyon, and buck brush intermixed with willows (*Salix spp.*), Oregon ash (*Fraxinus latifolia*), and box elders (*Acer negundo*).

Holstein (1984) has noted that because other upland oak species share the tolerance for poor soil aeration typically exhibited by the more riparian valley oak (*Quercus lobata*), these species can occasionally dominate riparian communities. For example, blue oak (*Q. douglasii*) woodlands are found along Mitchell Creek in Contra Costa County and Englemann oaks (*Q. engelmannii*) can be found along creeks in San Diego County.

An extensive review of the ecology of southern California riparian habitats was prepared by Faber et al. (1989). Specific depths, frequency, and duration of flooding were not addressed; however, numerous examples of non-riparian species occurring within the riparian zone were reported. In a study of plant distribution gradients between riparian and upland habitats along the west fork of the San Gabriel River, Brothers (1984, in Faber et al. 1989) found that the vegetation in a riparian zone included a few species which were riparian and a much larger number of species from adjacent non-riparian areas intergrading into the riparian zone.

Vegetation surveys of four coastal streams in Santa Barbara conducted by Ferren (1983, in Faber et al. 1989), recorded the presence of coast live oak (*Quercus agrifolia*), toyon, and California coffeeberry (*Rhamnus californica*) intermixed with riparian vegetation on the crest of banks above the zone of seasonal inundation. It was concluded that these species were tolerant of occasional flooding and saturated soils.

Hanes (1976, in Faber et al. 1989) recorded the presence of components of the mixed evergreen forest, including canyon live oak (*Quercus chrysolepis*) and big-cone Douglas fir (*Pseudotsuga macrocarpa*), within riparian associations in canyons between elevation 2000 and 5000 feet in the San Gabriel Mountains.

Hanes et al. (1989) reported the presence of species commonly found in chaparral or desert plant assemblages within alluvial scrub communities. These plant communities form on major alluvial fans at the mouths of river canyons along the coastal side of the San Gabriel, San Bernadino, San Jacinto mountains and lesser flood plains. These outwashes are characterized by sandy, rocky alluvia which experience infrequent episodes of severe flooding. Included with the typical riparian scrub were chaparral species, such as chamise, mountain mahogany (*Cercocarpus sp.*), and California juniper (*Juniperus californica*).

Locally, a number of tree and shrub species normally found at higher elevations in the foothills and in chaparral associations have been recorded along the lower American River Parkway (Sacramento County Department of Parks and Recreation, undated; Sanders et al. 1985). These species include interior live oak, blue

oak, California buckeye, digger pine, western redbud, California coffeeberry, toyon, bush lupine (*Lupinus albifrons*), deerweed (*Lotus scoparius*), yerba santa (*Eriodictyon californicum*), bush penstemon (*Penstemon breviflorus*), chamise, buck brush, chaparral honeysuckle (*Lonicera interrupta*), and hollyleaf redberry (*Rhamnus crocea*).

Vegetation within the California Exposition (Cal Expo) flood plain, which is located along the lower one-fifth of the parkway, was investigated by the Sacramento County Department of Parks and Recreation (Wymer 1987). Species typically associated with the foothill region were present between the river and the flood control levee. These species included deerweed, blue oak, and interior live oak.

These studies do not provide an indication of level of flood tolerance; however, the presence of these species within riparian corridors indicates they are indeed more tolerant of flooding than would be expected, given their "normal" habitat.

5.0 SITE INVESTIGATIONS

As noted above, a number of species for which flood tolerance data are lacking occur in the American River canyon (Table 3). This necessitated alternative methods to estimate flood tolerance for those species. Site investigations were conducted at four locations which experience periodic flooding and contain vegetation assemblages similar to the Auburn site. It was proposed to compare signs of gross vegetation mortality against known flood events to make rough estimates of tolerance based on the duration and elevation of the flood events. The four sites examined included the American River canyon at Auburn, the Sacramento River below Keswick Dam, the lower American River immediately above the Sunrise Bridge, and four flood control reservoirs within the San Gabriel Mountain range.

5.1 Flood of 1964. In late December of 1964, a severe rainstorm lashed California, Oregon and Washington, causing extensive flooding throughout the area. The storm was rated variously as a 100-year, 200-year, or greater event depending on location. Conifer forests in northwest California were flooded to depths as great as 80 feet (U.S. Forest Service 1965; Rantz and Moore 1965). Locally, the storm caused the failure of Hell Hole Dam on the Rubicon River and washed out the Highway 49 bridge over the North Fork and the Greenwood Bridge on the Middle Fork. The peak discharge was estimated to be 310,000 cfs on the Middle Fork just above the confluence with the North Fork (Mullen et al. 1986). Published reports (U.S. Forest Service 1965) and personal observations by one of this report's authors (A.T. Leiser) indicated that damage was principally from landslides, windthrow in waterlogged soils, and physical damage from floating debris, while mortality due to inundation appears to have been negligible.

Becking (1968) reported the die-back of over 267 redwoods and an unspecified number of Douglas fir along a one-mile reach of Bull Creek within the Rockefellar Forest following the floods of 1964 and 1966 resulting from the deposition of over 4 feet of very fine sediment. Becking postulated that the short interval between the periods of sediment deposition between the 1964 and 1966 floods did not permit sufficient time for new root regeneration and resulted in the observed mortality. The report did not provide any estimate of the percent loss represented by the 267 dead trees for the total inundated area.

The flooding also resulted in severe landslides. Within the Klamath and Six Rivers National Forests, most landslides were found along river and creek channels where saturated bodies of unstable soil was undercut by abnormally high waters from heavy precipitation and melting snow. In addition to causing slides, bank-cutting itself was responsible for stripping enormous quantities of soil from channels, and caused countless trees to be uprooted. Slides also occurred well above the stream channels and were generally associated with unstable soil materials, especially in areas underlain with serpentine rock, or in areas disturbed by roads, logging, fire, or

livestock grazing. However, some landslides were associated with no previous disturbances. In total, of the hundreds of timber cut patches within the forests, approximately five percent or less experienced mass movement of soil in the form of landslides (U.S. Forest Service 1965).

Our field investigations revealed no signs of residual vegetation damage from this event in the American River canyon. Such signs should be manifested by differences in the age classes of vegetation along elevation gradients subjected to differential flood durations, or remnants of dead vegetation.

5.2 American River Canyon. In 1973, the U.S. Bureau of Reclamation (USBR) constructed a cofferdam at the site where the proposed flood-control dam would be built. The purpose of the cofferdam was to protect the construction area of a large multipurpose Auburn Dam. Originally, the cofferdam was constructed to a height of approximately 200 feet, which extended from elevation 500 feet (msl) at the streambed to approximately 700 feet (msl) at the dam crest. In 1978, the cofferdam was enlarged to a crest elevation of 715 feet. A diversion tunnel was constructed along the left bank of the cofferdam with the invert approximately 10 feet below the river bed at elevation 490 feet (msl). The cofferdam was breached during the storms of February 1986. In the 13-year period of operation, the cofferdam retained significant flood flows on at least four occasions. Because the cofferdam was, in fact, a small flood control dam, any residual impacts resulting from its operation could provide insight into impacts expected from a larger flood control facility. In order to analyze potential flood impacts, stage-duration curves were generated from USBR flood monitoring reports (Appendix C) to determine the approximate duration of flooding at different canyon elevations behind the cofferdam.

The longest continuous flooding of the canyons behind the cofferdam occurred during the inundation event in January 1978. Water was impounded above the diversion tunnel for a period of approximately 15 days; however, the maximum elevation of the flood pool was only 530 feet (msl), or 30 feet above the channel bed, and this elevation was maintained for less than 24 hours (Figure 1). The water surface elevation of the flood pool was above elevation 515 feet for 2 days and above elevation 505 feet for 8 days.

The inundation event in February-March 1978 had a maximum flood pool elevation of 523 feet (msl). The water surface elevation in the flood pool was above elevation 515 feet for approximately 2.5 days and above elevation 505 feet for 6 days. The exact duration of the event is not known because the flood watch conducted by USBR ended before the pool was completely evacuated. However, it is estimated that the total duration was approximately 11 days (Figure 1).

The inundation event in February 1982 was a flash event of short duration. The exact duration of the event is not known because the flood watch was not initiated by USBR until the water reached the 540-foot elevation. By extrapolation, it is estimated that the total duration of the event was at least 3 days. The flood pool peaked at elevation 636 feet (msl), or 136 feet above the channel bottom immediately behind the cofferdam (Figure 2).

The largest flood of record during the operation of the cofferdam occurred in February 1986. It reached a peak elevation of 716 feet (msl), at which time the cofferdam failed. The estimated duration of inundation was 3.5 days (Figure 2).

During these flood events some trees were toppled, localized erosion occurred, and sediment was deposited along the banks. These impacts were particularly evident after the 1986 event, due largely to channel and bank scour downstream from the cofferdam resulting from the rapid cofferdam failure. However, no gross loss of vegetation was observed upstream of the cofferdam after these events (John Cleary, California Department of Parks and Recreation, pers. comm. 1990).

FIGURE 1. Stage-Duration Curves at Auburn Cofferdam for Flood Events in 1978

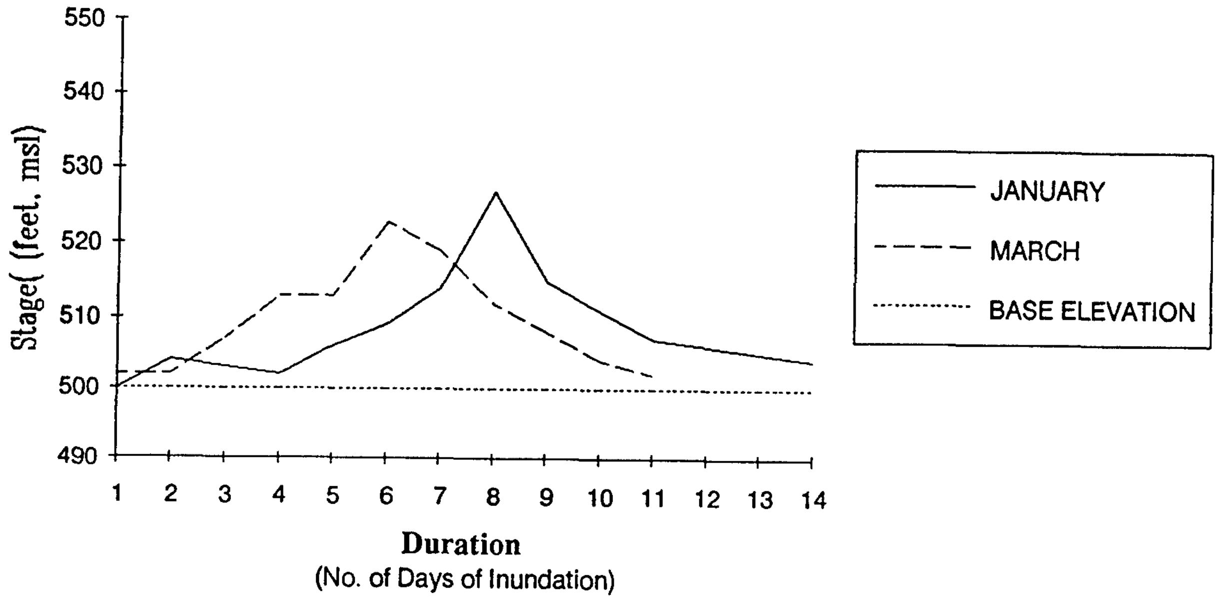
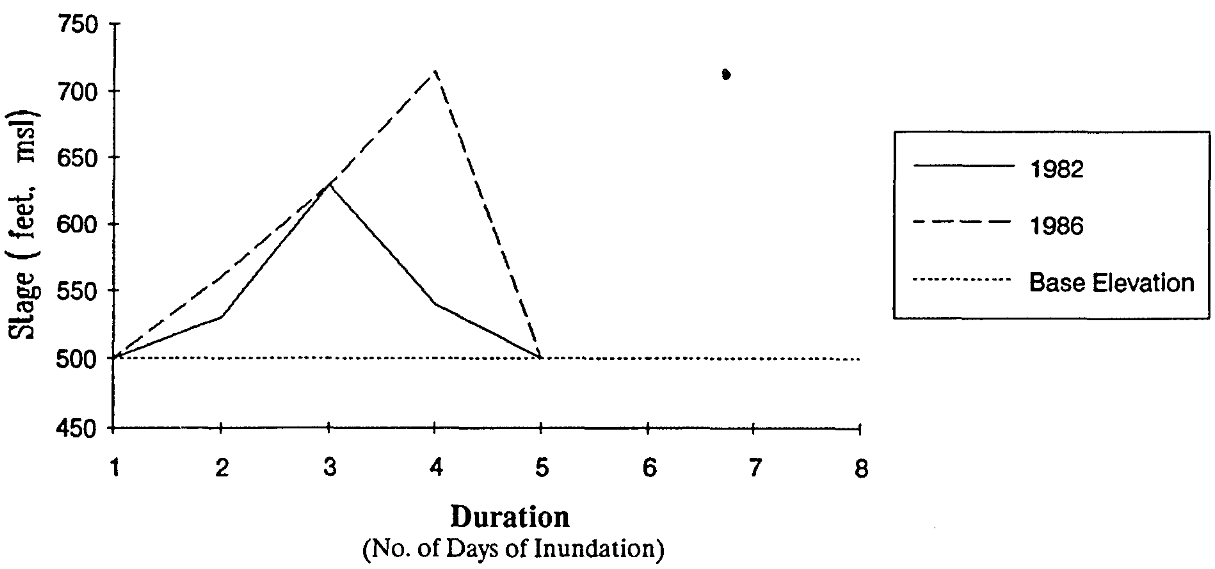


FIGURE 2. Stage-Duration Curves At Auburn Cofferdam For Flood Events in February 1982 and February 1986



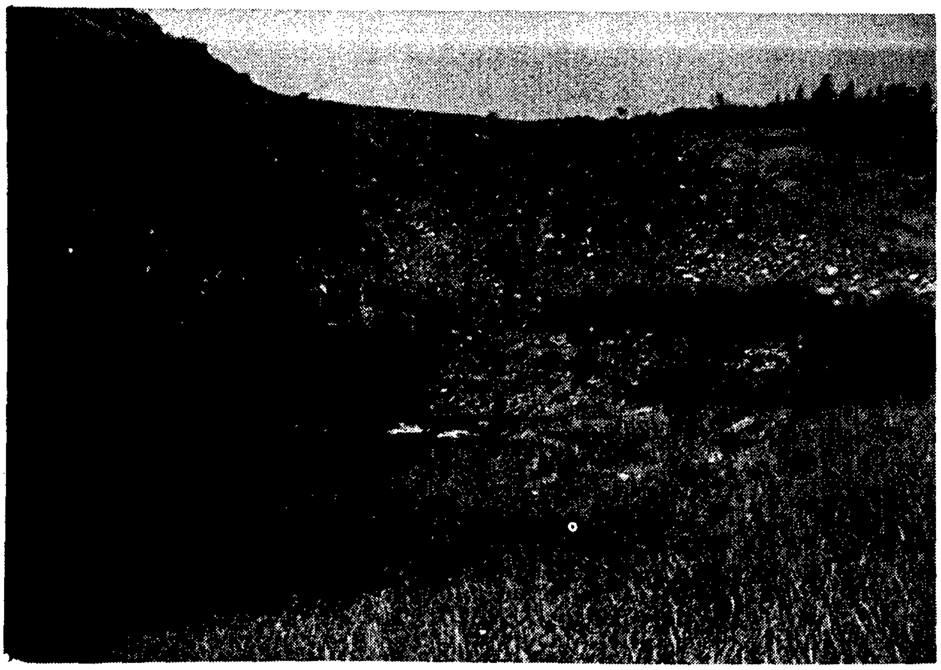
On the basis of site examinations, no evidence of vegetation die-back resulting from the previous inundation events was observed (Figures 3 and 4). It would be expected that if flood tolerance thresholds of the canyon vegetation were exceeded, mortality would be characterized by a band or bands of dead woody vegetation (at least of the sensitive species) delimiting the upper elevation of the flood pool, or the levels at which flooding durations exceeded critical tolerance thresholds for those species. A similar effect is observed in fluctuation zones of newly impounded reservoirs. As indicated in Figures 3 and 4, other than the irregular natural delineations between vegetation types, no discernable horizontal banding patterns were observed in any of the vegetation communities examined.

One particular reach along the left bank of the river (Section 11, T-12-N, R-8-E) contained some downed digger pines. The downed trees were older trees, some with broken tops. The bark was missing from some, indicating that they had been dead for many years. Many of the digger pine above the flooded elevation appeared weakened, and dead and downed specimens were also observed, and many were in an advanced state of decay. Of about 35-40 examined closely, only two were found that appeared to have been dead for less than 5-10 years. Many of the specimens examined exhibited evidence of beetle infestation. In the area of the downed trees, both above and below the flood elevation, there were a number of young vigorous digger pine that were estimated to be in the 10- to 20-year age class. From the overall examination, it was concluded that the area was one where the older trees were perhaps weakened by fire, beetle attack, or old age and some undoubtedly were dead and down prior to the flooding in 1986.

An examination of the relative growth of a few representative taxa from the mixed oak-conifer woodland and riparian communities for the 1985 through 1990 growing seasons was performed. The specimens examined were at elevations subjected to the 1986 flood on the Middle Fork above the confluence with the North Fork, and on the North Fork below the confluence. Data were taken from side branches displaying average vigor (Table 4). Because many species of woody plants have a determinate growth pattern, all of the leaf or needle primordia that will develop in a given year are formed during the previous growing season in the winter resting bud. Although environmental conditions during the growing season exert some influence, growth potential is primarily determined when the leaf initials were formed the previous season. Thus, the growth in 1985 was largely determined by environmental conditions which prevailed in 1984. Growth flushes are identified by the annual budscale rings, at least until secondary thickening of the bark occurred. The examination revealed that for most species shoot growth was very similar for the 1985 and 1986 growth flushes. Shoot growth in 1987 and 1988 was equal to, and often exceeded, that for the previous two years. There was no evidence that the flood event of February 1986 had any deleterious effects on the growth made in the 1986 or 1987 growing seasons. Evidence of reduced growth in 1988 and 1989 may be attributable to several consecutive drought years.

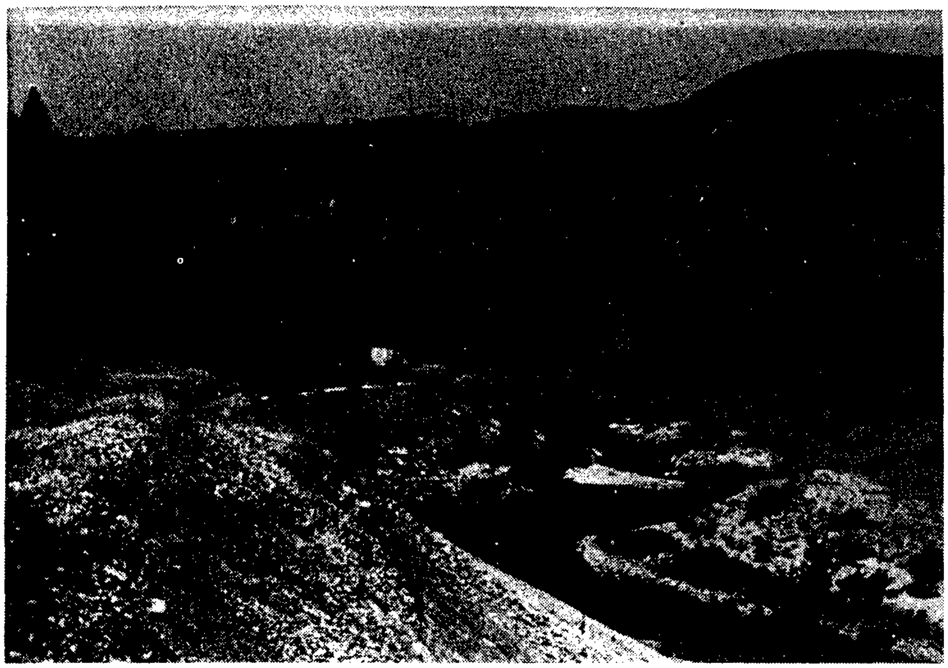
Site examinations included a search for evidence of regeneration, i.e., young seedling plants which might have grown during the period for which flood data are available (1978 - 1986). Establishing ages of young plants growing in the wild is difficult. Seedlings of some species, conifers and oaks for example, may make little top growth for two or three years until a good root system is established. After root establishment, top growth may be quite rapid.

Many seedlings of several riparian species that appeared to be about 5-7 years old were found. These included willow, cottonwood (*Populus fremontii*), alder (*Alnus rhombifolia*), and a few Oregon ash (*Fraxinus latifolia*). Young plants of a suffrutescent penstemon (*Penstemon sp.*) were fairly common. The presence of the alder was particularly interesting because of the absence of nearby parental stock, suggesting that seeds had been transported from further upstream. Young bigleaf maples (*Acer macrophyllum*) were observed in wet areas next to the abandoned quarry along the Middle Fork.



A. View of cofferdam and diversion tunnel at RM 20.1. Invert of tunnel is approximately 490 feet (msl). River bed elevation is approximately 500 feet (msl).

B. View of left bank of North Fork American River from immediately upstream from cofferdam (RM 20.1). Streambed is approximately 500 feet (msl).



A. View of right bank of Middle Fork American River approximately 1.25 miles upstream from confluence with North Fork. Streambed elevation is approx. 560 feet (msl) and roadway elevation is 640 feet (msl)

B. View of left bank of Middle Fork American River approximately 1.25 miles upstream from confluence with North Fork. Roadway elevation is approx. 640 feet (msl).

FIGURE 4

TABLE 4.
REPRESENTATIVE GROWTH FLUSHES (IN INCHES) FOR RIPARIAN AND CHAPARRAL SPECIES BELOW THE 600-FOOT CONTOUR IN THE AMERICAN RIVER CANYON[1]

SPECIES	1985	1986	1987	1988	1989	1990
Oregon ash *Fraxinus latifolia*[2]	6.0	8.5	3.5	1.0	2.0	7.5
Ponderosa pine *Pinus ponderosa*	7.3	5.7	3.3	4.0	4.7	
Digger pine *Pinus sabiniana*	--	13.5	9.0	9.0	4.0	6.0
Fremont cottonwood *Populus fremontii*	12.0	9.0	13.5	11.0	13.0	12.5
Canyon live oak *Quercus chrysolepis*	5.7	6.7	8.3	5.1	4.7	5.8
Interior live oak *Quercus wislizenii*	7.0	8.0	5.5	3.0	5.5	6.5
California laurel *Umbellularia californica*	4.0	4.0	3.5	3.7	6.0	6.0

[1]Located in Sections 11, 12, and 14; T-12-N; R-8-E; Placer County
[2]Many Oregon ash specimens had strong basal sprouts with 2-4 feet of growth made in both 1986 and 1987 growing seasons.

Very young conifers were not seen, but scattered ponderosa pine, digger pine, and Douglas fir estimated to be between 15 and 25 years of age, were observed. Some of these were observed at elevations that flooded during the 1982 and 1986 events. No evidence was found of young conifers that might have died during these events. It is particularly difficult to establish the age of many chaparral species because initial growth is slow and browsing of young plants is frequent. Although ages could not be ascertained, based on the range of plant sizes, the populations appeared to be a mix of age classes.

Based on limited field observations, no evidence was found of detrimental physiological effects of past flood events on survival or regeneration of vegetation along the upper American River near Auburn. These observations suggest that, at a minimum, the vegetation within the lower elevation zones are able to tolerate total submergence for periods up to 3 days and inundation of root crowns for periods over 10 days during the winter season without any obvious signs of mortality or stress. These observations are consistent with the findings reported in the literature cited above. There is limited evidence that dead or older trees, such as weakened digger pine, may fall during or after a flood; however, young to mid-sized digger pine did not appear to be affected.

5.3 Sacramento River at Redding. The data recorded at the American River site are limited based on the elevation and duration of inundation and the seasonality of previous flooding. This lack of information occasioned the examination of a site on the Sacramento River between Keswick Dam and the City of Redding. The area is known to flood on a regular basis and is located at approximately the same elevation as the Auburn site. Further, the vegetation at this site is similar in composition to that found in the American River canyon.

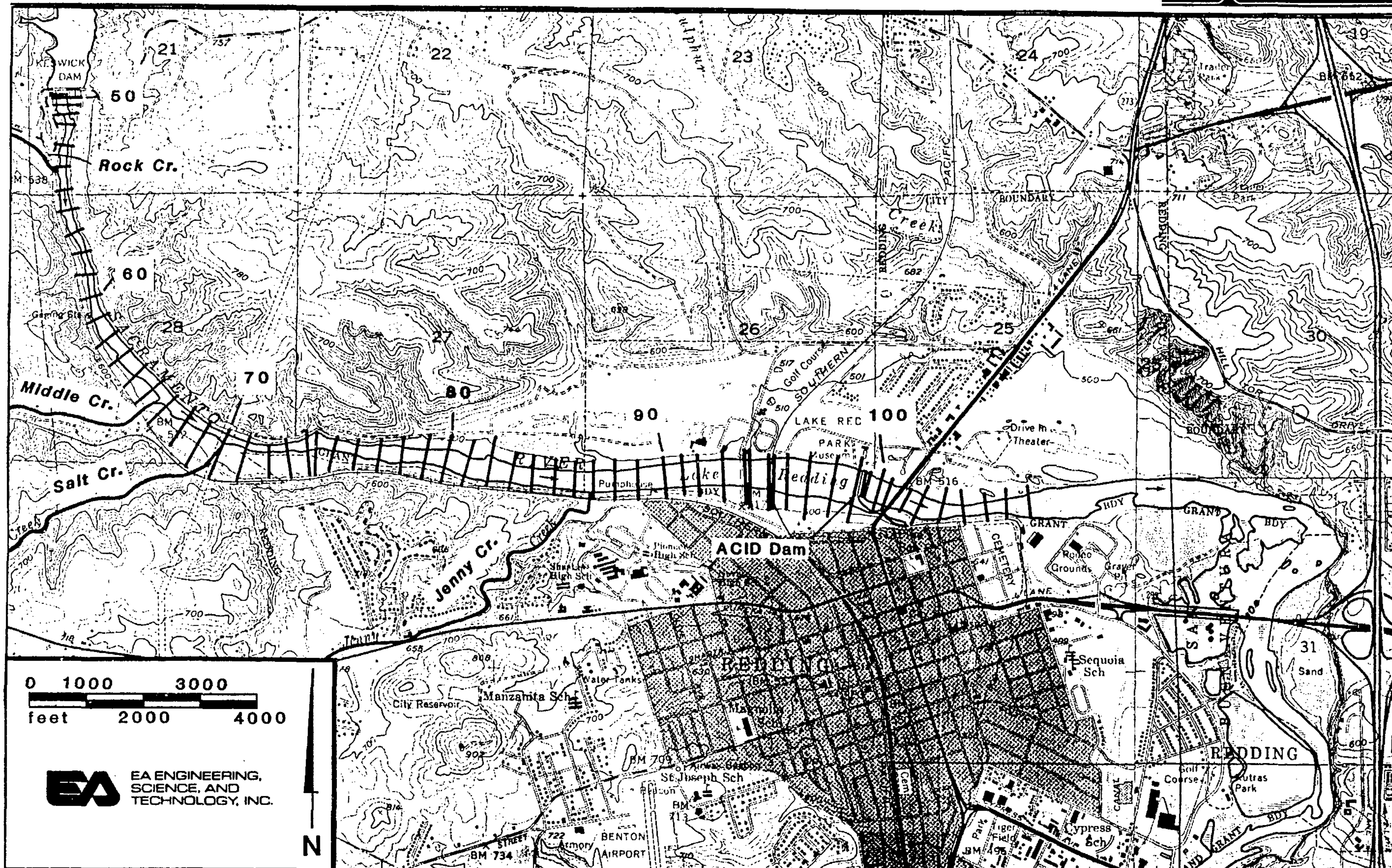
The Sacramento River between Keswick Dam and the City of Redding is subject to periodic high flows during the winter. Because of the constricted channel below the dam, the outflow occasionally floods a belt of foothill woodland and chaparral vegetation when releases exceed about 20,000 cfs. A considerable volume of hydrologic data has been collected over several years for this reach (City of Redding 1986). A map of the area showing the stations numbered from 50 (at the foot of Keswick Dam) to 100 (below the Anderson-Colusa Irrigation District Dam at Lake Redding Park) is shown in Figure 5. From Keswick Dam to Middle Creek, the river flows through a narrow channel. A fairly wide floodplain is located on the right (south and west) bank of the river beginning just before Middle Creek and extending to STA 77. The floodplain narrows and then widens again at about STA 90.

The vegetation along the banks of the river varies considerably between the upstream end of the pool at the base of Keswick Dam and the lower end of the ACID Dam site (Figure 6). The floodplain is very narrow and dry at the upper end and becomes wider and more mesic at the lower end. Below Keswick Dam, willows grow in patches interspersed with large expanses of greenstone bedrock and areas of shallow soils. The chaparral belt projects into and intermingles with the riparian willows. A wide terrace of riparian vegetation is located along the right bank in the midsection of the pool, with willows grading into cottonwoods, sycamores, and a few digger pine. On the left bank, the terrace is narrow or lacking. Mixed oak woodland-chaparral grade into chaparral at higher elevations. The chaparral is thinner in the areas flooded than above the inundation zone, which is probably attributable to thinner, coarser, and more droughty soils, and exposed bedrock due to the effects of scour rather than to differences in densities caused directly by flooding and inundation. This pattern of thinner vegetation just above the riparian zone is quite common in California riverine areas, particularly in gravel bar areas between vegetated banks and the toe of canyon escarpments. In the lower reaches, the right bank has been altered by agricultural practices, while the left bank has been altered by urban development and the city park.

The minimum, average, and maximum monthly flows for this reach are shown in Figure 7. Flows can equal or exceed 20,000 cfs from November through February or March when most woody plants are not making active vegetative growth, and into April when they are beginning the growing season. Maximum flows for the years 1974 to 1983 are summarized in Table 5. Flows exceeded 14,000 cfs on eight occasions, 35,000 cfs on five occasions, and 60,000 cfs on two occasions during this period. Based on the limited period of analysis, these events represent the 1-year, 2-year, and 5-year flood events, respectively.

The average annual duration of flows is given in Figure 8. Flows exceed 15,000 cfs about 12 percent of the time (44 days annually); exceed 20,000 cfs about 3 percent (11 days); exceed 30,000 cfs about 1 percent (3.6 days); and exceed 35,000 cfs about 0.75 percent (3 days).

At high discharges, water levels are raised disproportionately near Keswick Dam compared to those at the ACID Dam because of the constricted channel between STA 52 and STA 75, but some flooding occurs even near the ACID Dam location. These pool elevations are shown in Figure 9. Table 6 tabulates the data from Figure 10 to show the approximate water surface elevations at STA 52 just below Keswick Dam for discharges of 30,000, 40,000, 50,000, 60,000, and 70,000 cfs, and includes elevations above the "normal" water surface elevation of 493 feet at the 6,000 cfs discharge. At 35,000 cfs (2-year flood), the elevation increase is about 16 feet, and at 60,000 cfs (5-year flood) the increase is about 19-20 feet. Figure 10 displays the stage-duration curve for the Sacramento River below Keswick Dam during the February 1986 storms. This curve is based on discharges reported by USGS (Mullen et al. 1987) at the Keswick Dam gaging station. Flow volumes

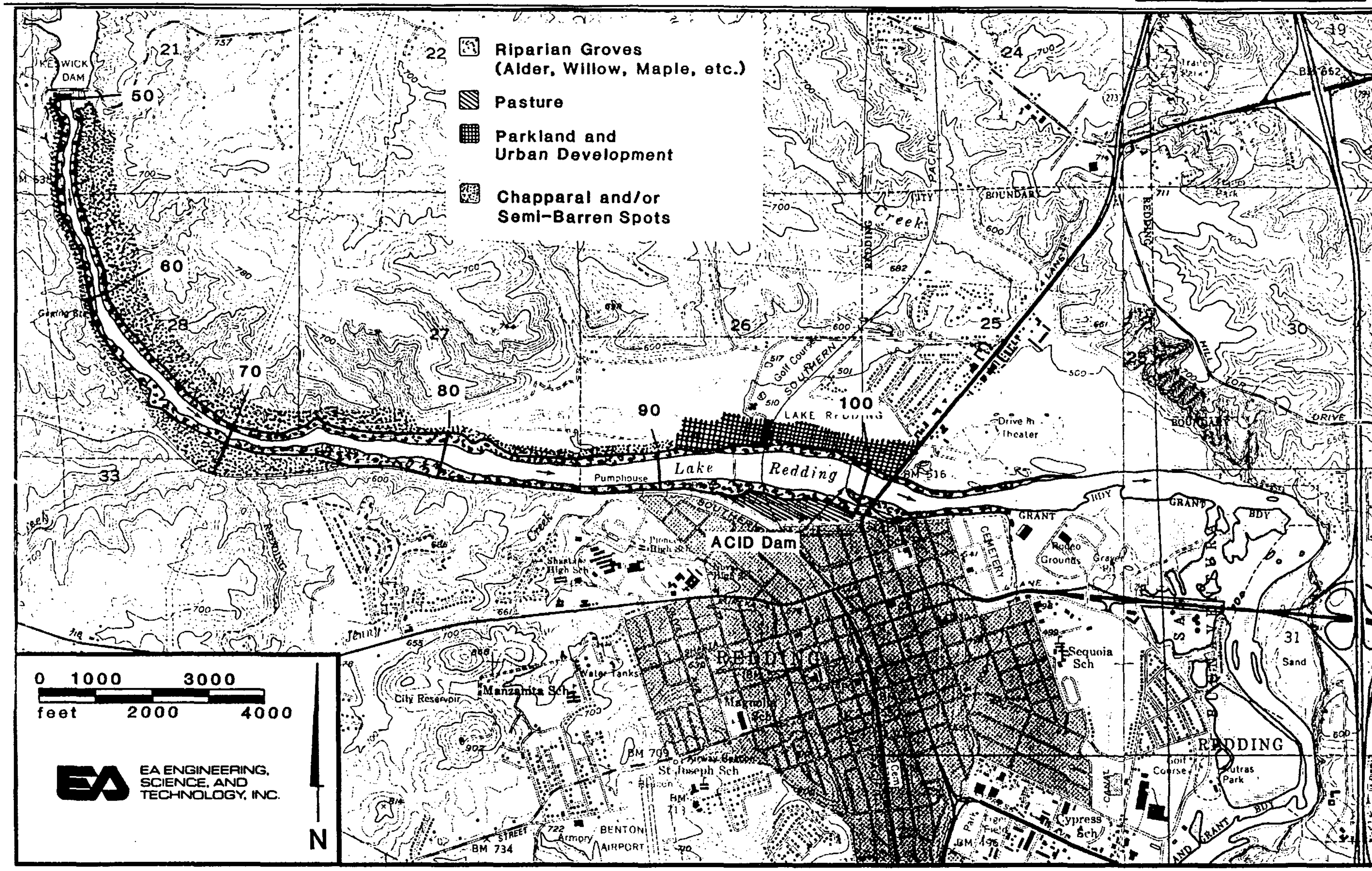


Sacramento River at Redding, with tributary creeks and hydrological transects.

Source: City of Redding (1986)

FIGURE 5

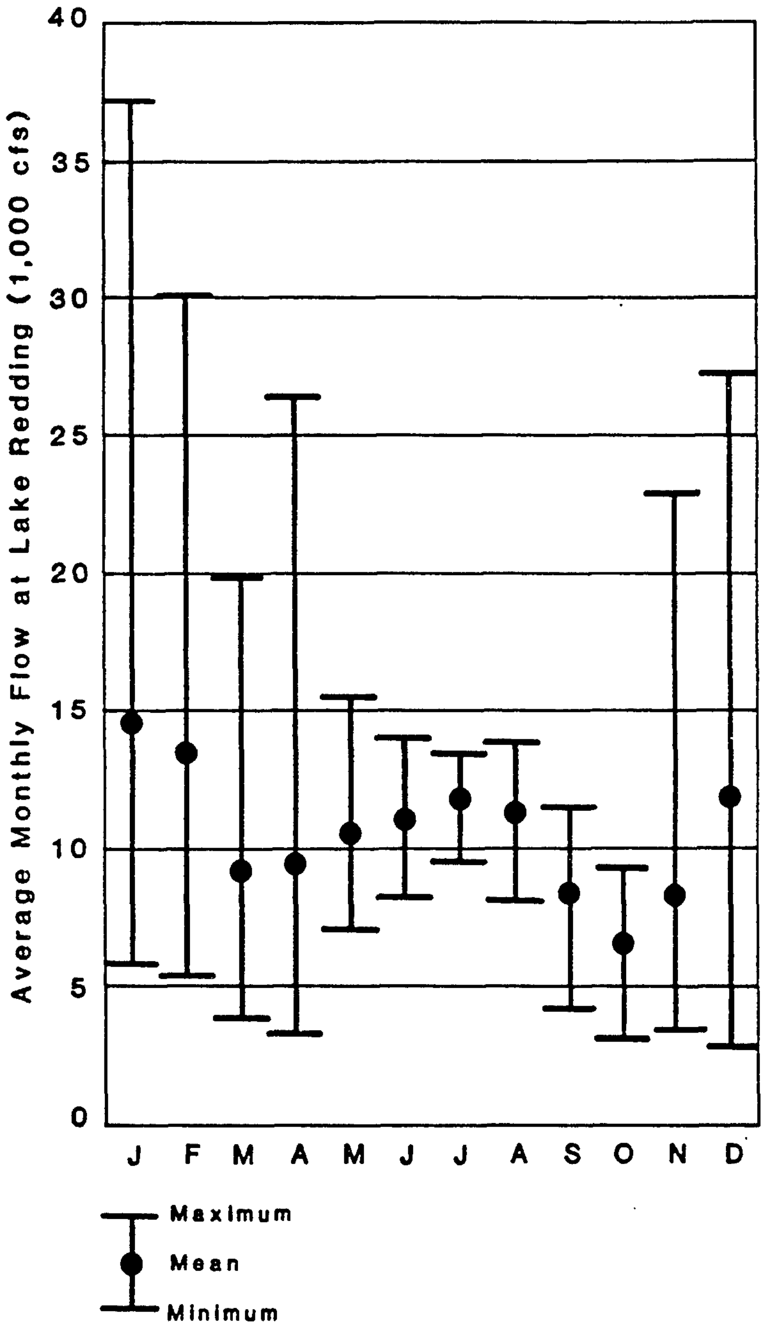
FUGRO McClelland



Riparian vegetation at Lake Redding.

Source: City of Redding (1986)

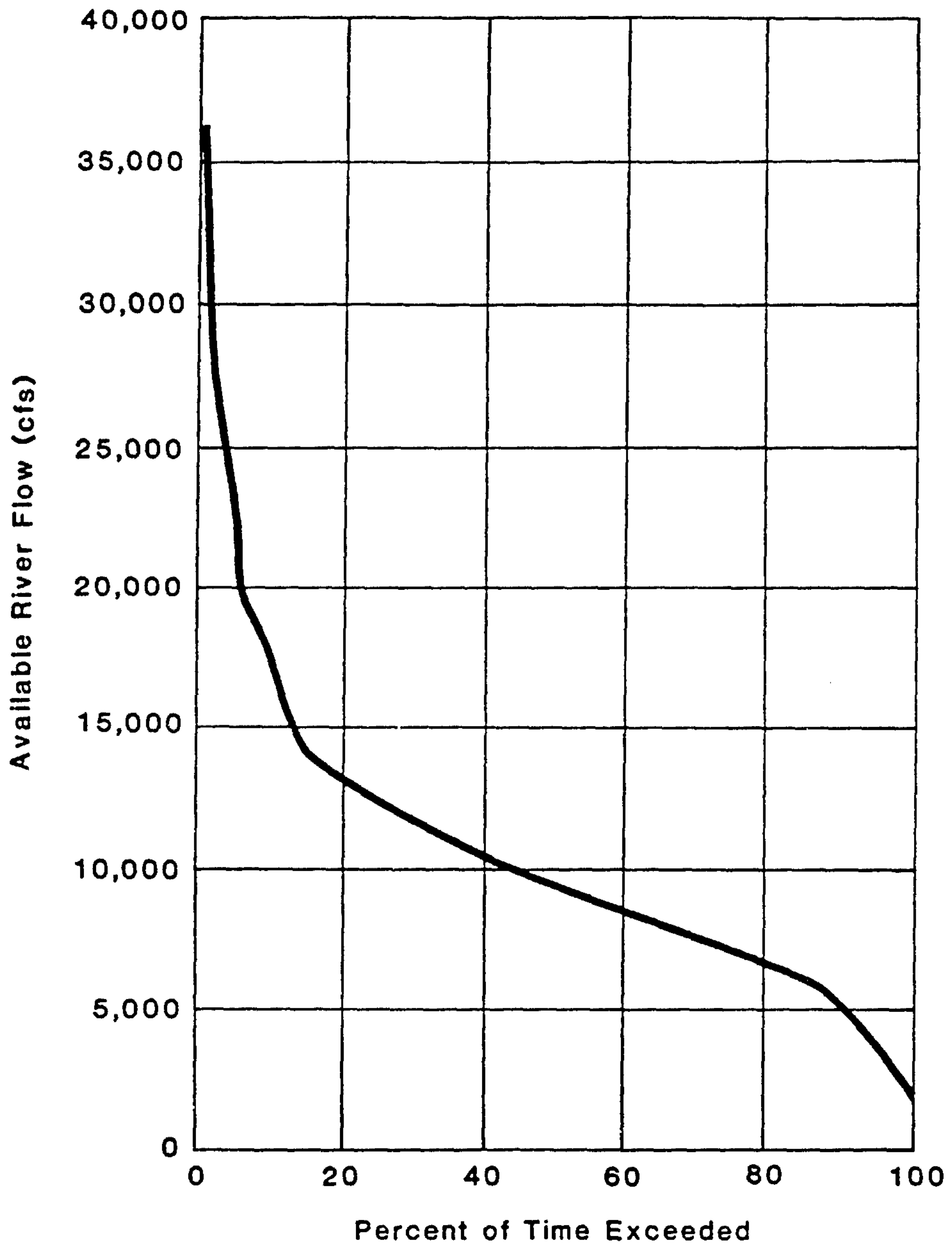
FIGURE 6



Monthly Average, Maximum, and Minimum Flows on the Sacramento River at Lake Redding, 1964-1978

Source: City Of Redding (1986)

FIGURE 7



Discharge Exceedance Curve for the Sacramento River at Lake Redding

TABLE 5.
ANNUAL DISCHARGES FOR THE SACRAMENTO RIVER AT KESWICK DAM
WATER YEARS 1974-1983[1]

YEAR	DISCHARGE (X1000 cfs)		
	Mean	Maximum	Minimum
1974	11.1	37.3 (MAR)[2]	5.9 (APR)
1975	9.6	13.7 (MAY)	4.1 (MAR)
1976	6.4	11.5 (JUN/JUL)	3.1 (DEC)
1977	8.1	39.3 (MAR)	2.4 (DEC)
1978	7.3	14.4 (JUL)	3.6 (APR)
1979	7.3	14.4 (JUL)	3.6 (APR)
1980	10.4	50.7 (FEB)	3.9 (OCT)
1981	8.2	14.4 (JUN/AUG)	3.8 (OCT)
1982	13.4	60.2 (DEC)	3.3 (OCT)
1983	18.2	64.3 (JAN)	5.2 (JAN)

[1]Source: City of Redding (1986)
[2]Month(s) in which maximum or minimum values occurred are in parentheses.

TABLE 6.
DISCHARGE-ELEVATION RELATIONSHIPS IN SACRAMENTO RIVER CANYON
BELOW KESWICK DAM[1]

ELEVATION (Mean Sea Level)	DISCHARGE (cfs)	ELEVATION ABOVE 493' BASE (ft)
493	6,000	0
499	14,000	6
502	20,000	9
506	30,000	13
509	40,000	16
511	50,000	18
512	60,000	19
515	70,000	22

[1]Adapted from City of Redding (1986)

(cfs) were converted to elevations using the USGS rating table for the gage (Appendix C). Discharges in excess of 30,000 cfs were sustained for almost 2 weeks and inundated the vegetation zones indicated on Figure 12a.

The reach between Keswick Dam and the City of Redding contains vegetation associations similar to those found at the Auburn site, including many of the same species (Table 3). Examination of the vegetation indicated no adverse effects from periodic dormant season flooding (Figures 11 and 12). Based on visual inspection, annual growth increments appeared similar to those for the same species above the flood zone. Occasional dead plants were observed, but these did not appear to occur any more frequently than dead plants above the flood zone. It should be emphasized that this flooding is quite frequent and, in total, may occur from 3 to 25 days annually.

5.4 Lower American River. Inspections of the lower American River Parkway substantiated the presence of typically foothill species along the riparian corridor as noted in Section 4.4. Species observed along the corridor include interior live oak, California buckeye, coffeeberry, buck brush, and toyon (Sacramento County Parks and Recreation Department, undated; and Sanders et al. 1985). These species were observed immediately adjacent to the bicycle trail between RM 20 and 22. According to the 7.5 minute USGS topographic maps (Citrus Heights and Folsom quadrangles), the trail in this area is situated between elevation 70 feet and 100 feet (msl) (Figure 13).

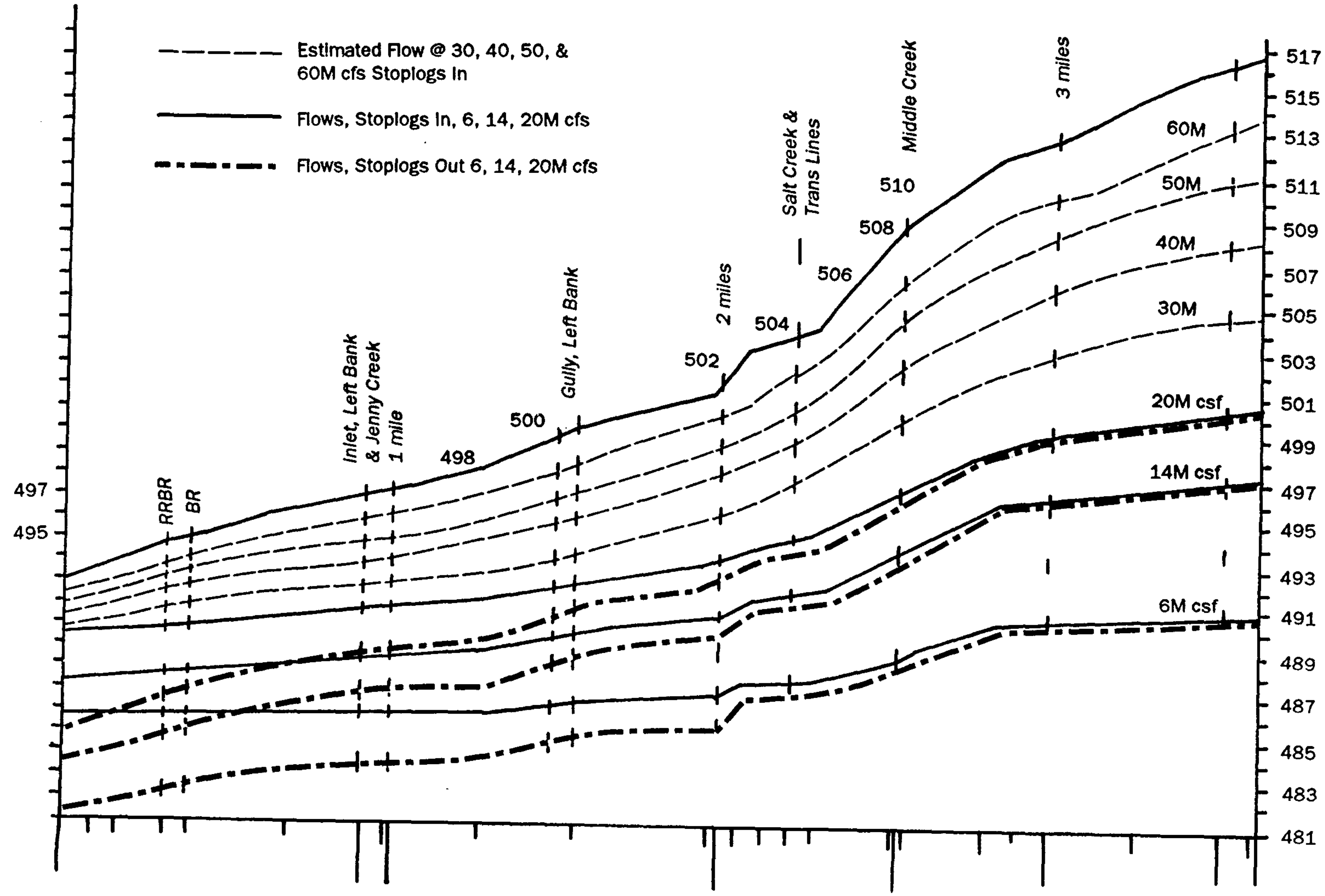
Based on a stage-duration curve generated from discharge data from the Fair Oaks gaging station (RM 22.5) during the February 1986 storms, water surface elevations exceeded elevation 80 feet for over 12 continuous days; exceeded elevation 85 feet for over 9 continuous days; exceeded elevation 90 feet for over 5.5 continuous days, and exceeded elevation 95 feet for over 3.5 days (Figure 14).

Analysis of aerial photography of the lower American River taken on February 18, 1986 by the California Department of Water Resources (1986) showed that an extensive area southeast of the Sunrise Bridge was inundated below the 100-foot elevation contour (Figure 13). The extent of flooding shown on the aerial photographs was validated with ground level photographs taken by John Newby, Sacramento County Parks and Recreation Department (pers. comm. 1991).

Based on these hydrologic and photographic data, vegetation within the elevation range was flooded between 3.5 and 12 days. Foothill vegetation observed in areas flooded in 1986 included interior live oak, coffeeberry, and California buckeye. Examination of the vegetation in 1990 did not reveal any evidence of die-back resulting from the 1986 inundation.

5.5 San Gabriel Mountain Reservoirs. The assessment of the impacts of flood control reservoirs in Southern California focussed on four sites including the Live Oak Detention Reservoir, Cogswell Reservoir, San Gabriel Reservoir, and Morris Reservoir. The rationale for selecting the sites in southern California included the fact that the reservoirs have been in operation for up to 70 years; site conditions are similar to the Auburn site (e.g., vegetative cover, elevation, steep and unstable terrain, and precipitation); and the operation of the reservoirs have resulted in greater impacts to vegetation than are expected to occur from operation of the proposed flood control dam at Auburn (Cummings 1991a).

Live Oak Detention Reservoir is operated exclusively as a dry basin. The bottom of the reservoir is vegetated in riparian species which grow vigorously in spite of over 20 feet of inundation for one week in March 1991. The vegetation is periodically removed to facilitate sediment removal. Because of the small size of the reservoir, the conditions would be representative of the inlet at the Auburn dam or along less steep tributary channels.

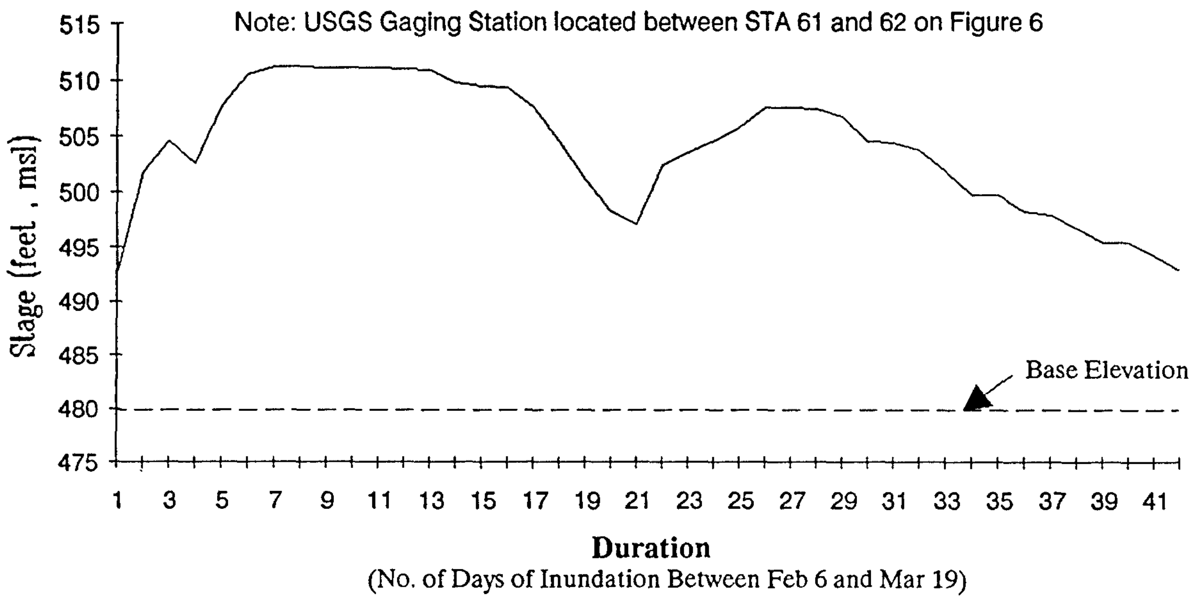


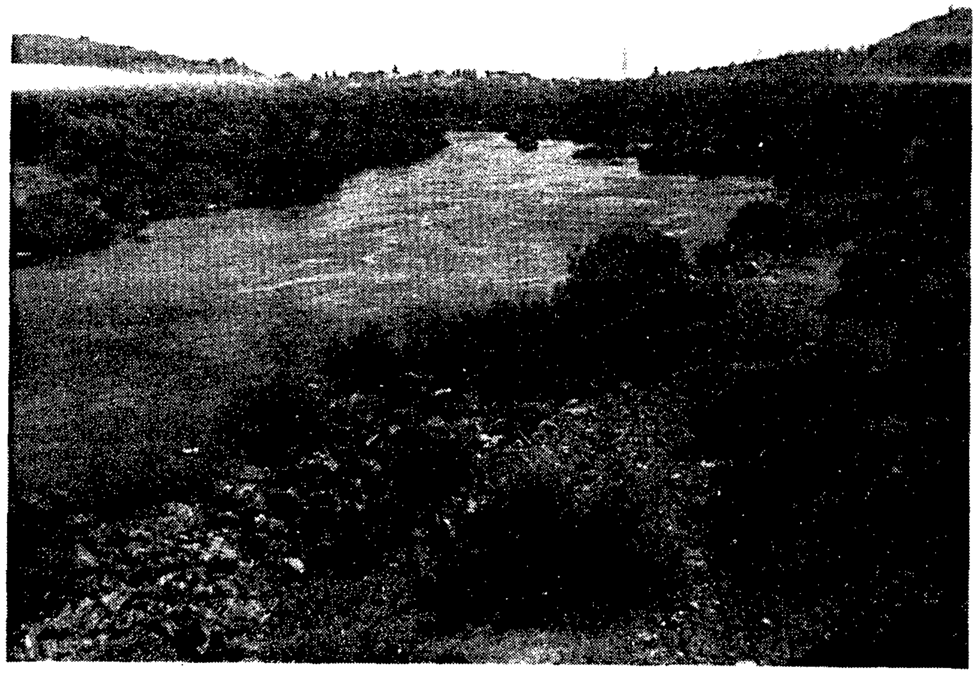
Approximate Pool Elevations at Various Distances Upstream of the ACID Dam for Various Discharges With Stoplogs Out and With Stoplogs In

Source: Adopted from the City of Redding (1986)

FIGURE 9

Figure 10. Stage-Duration Curve for the Sacramento River Below Keswick Dam During the February/March 1986 Storms.





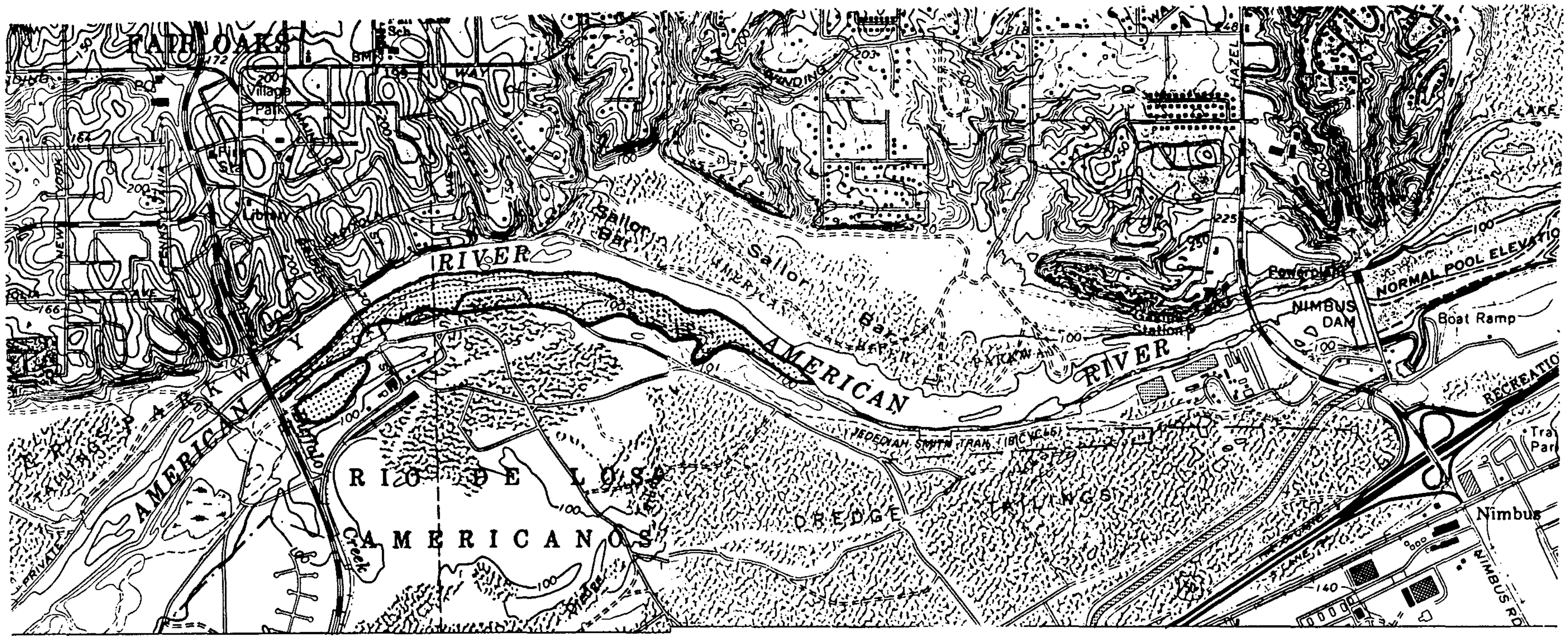
A. Periodically inundated chaparral vegetation below Keswick Dam on Sacramento River at approx. STA 55 (downstream from foot bridge).

B. Periodically inundated chaparral vegetation below Keswick Dam on Sacramento River between STA 55 and STA 60. Species include manzanita (Arctostaphylos spp.), Ceanothus spp., and redbud (Cercis occidentalis).

A. Approximate zones of inundation at 60,000 cfs event (1) and 30,000 cfs event (2) below Keswick Dam on Sacramento River. Vegetation includes manzanita (Arctostaphylos spp.), Ceanothus spp., and interior live oak (Quercus wislizenii).

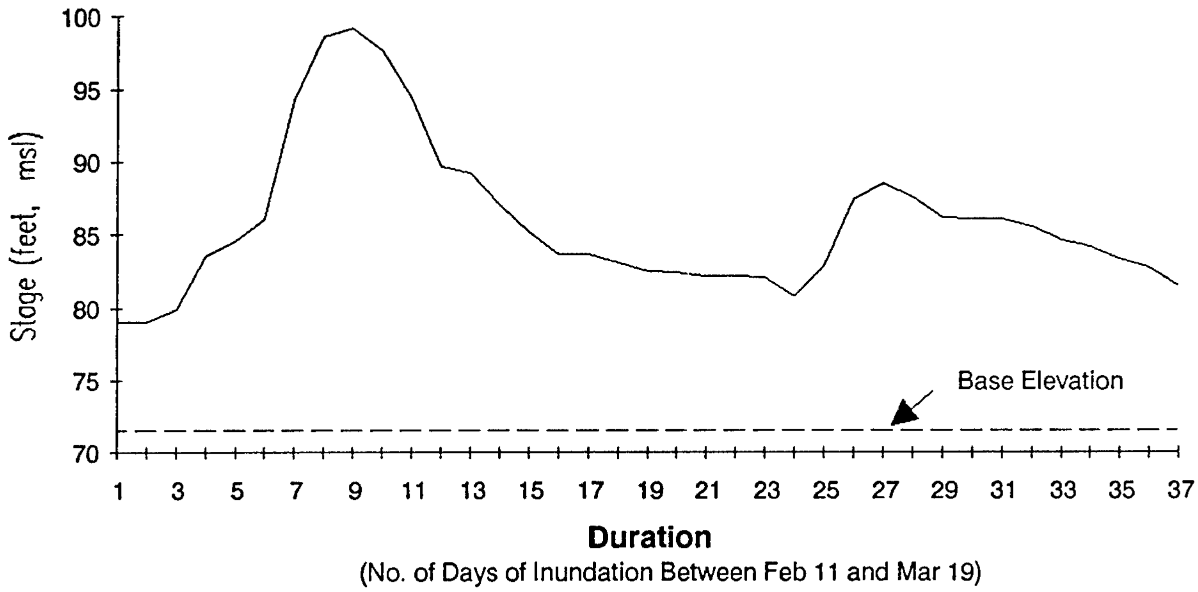
B. Periodically inundated chaparral vegetation below Keswick Dam on Sacramento River at approximate STA 76. Vegetation includes manzanita (Arctostaphylos spp.), Ceanothus spp., toyon (Heteromeles arbutifolia), and digger pine (Pinus sabiniana).

FIGURE 12



Segment of American River Parkway flooded during February 1986 storm

FIGURE 14. Stage Duration Curve for American River at Fair Oaks Gage During February/March 1986 Storms



Cogswell Reservoir is operated with a storage pool and a substantial flood water detention capacity above the normal operating pool. The reservoir slopes are steep and a clear break in the vegetation observed at the ordinary operating level. Annual grasses with a scattering of shrubby species dominate the vegetation in the detention zone of the basin, but exposed ground dominates the zone below the normal operating level with only occasional annual plants and a few willow sprouts present. Above the detention zone, a clear break occurs between the upper limit of the reservoir and the vegetation above the reservoir. This demarcation appeared to be the result of the original clearing and grubbing of the reservoir. During the inspection by DWR staff, the reservoir was completely drained below the normal pool elevation. Since the initial clearing and grubbing of the reservoir basin, a number of chaparral genera, including *Eriodictyon, Arctostaphylos, Eriogonum,* and *Baccharis*, have invaded the zone between the normal pool and maximum pool elevations and are periodically inundated for periods in excess of 30 days. As a result of a flash event in March 1991, in which the water surface rose 74 feet in one day, suffrutescent ("half-woody") buckwheat (*Eriogonum sp.)* plants were killed as a result of the inundation. However, woody chaparral species survived and prospered despite deep submergence ranging from several days up to three weeks and followed by a rapid drawdown (Cummings, pers. comm. 1991).

6.0 ESTIMATED WOODY PLANT LOSS FROM FLOODING

As indicated in previous sections, flood-induced mortality is a function of several factors, principal of which are season of inundation, duration of inundation, species tolerance, genetic and ecotypic variation within a species, age and vigor of individual plants, and slope and soil mantle stability. In estimating the potential loss of woody plants from flooding, a distinction has been made between direct or primary loss, and loss of plants from indirect or secondary causes. A third effect of flooding on the vegetation community is the relationship between flooding and regeneration.

6.1 Baseline Losses. Under unregulated conditions, the American River is subjected to periodic high flows which can inundate the American River canyon to different elevations depending on peak discharges. For example, during the flood of 1964, the reported flood height at the USGS gage on the Middle Fork of the American River was at elevation 616 feet, msl, or 64 feet above the channel bed datum. In 1963, the peak water surface elevation was recorded at elevation 595 feet, msl., or 43 feet above the datum. During the 1986 flood, the gage was destroyed by high water. These records provide an indication of maximum water surface elevation corresponding to peak flows, but do not provide an indication of the sustained flood elevations.

In order to estimate a baseline condition for the 7-day duration flood event with which to compare potential impacts of the proposed flood control dam, the maximum 7-day sustained water surface elevation was estimated. Using data generated by the U.S. Army Corps of Engineers (Chart 4 from Appendix K: Rain Flood Frequency Curves, Unregulated Conditions), the discharge corresponding to the 7-day sustained duration event for the 200-year, 100-year, 50-year, 20-year, 10-year, and 5-year flood events was estimated. However, because the discharge included inflows from the South Fork, the discharge was reduced by 33 percent. Further, because the gage datum of interest was located on the Middle Fork, the discharge was reduced an additional 35 percent to eliminate inflow contributions from the North Fork above its confluence with the Middle Fork (M. Rice, pers. comm. 1991). The adjusted discharge was then compared with the USGS Rating Table for the gage station in order to derive a water surface elevation corresponding with the estimated 7-day discharge. These data are presented below in Table 7. Consequently, it is assumed that the channel scour effects of inundation from the flood control dam would be less than experienced during unregulated flows since discharge velocities would be greatly reduced. As a result, the losses of vegetation associated with flooding below the 530-foot contour (e.g., 29 acres) have been eliminated from the loss estimate.

TABLE 7.
ESTIMATED WATER SURFACE ELEVATIONS OF THE 7-DAY SUSTAINED DISCHARGE FOR DIFFERENT FLOOD FREQUENCIES ALONG THE MIDDLE FORK OF THE AMERICAN RIVER.

FLOOD FREQUENCY[1]	ESTIMATED DISCHARGE[2]	ELEVATION ABOVE DATUM[3]	ELEVATION ABOVE MEAN SEA LEVEL[4]
200	60,900	33.6	585.6
100	47,850	29.9	581.9
50	39,150	27.1	579.1
20	29,150	23.5	575.5
10	20,450	19.9	571.9
5	14,360	17.0	569.0

[1]Recurrence intervals from Chart 4, Appendix M.
[2]Discharge from Chart 4, Appendix M adjusted by 0.435 (see text).
[3]Elevation from USGS Rating Table 26, Sta. 11433500.
[4]Gage datum at elevation 552.35 feet, NGVD.

6.2 Direct Losses. Direct or primary loss of plants from flooding is defined here as: 1) that loss due to changes in soils and in plant growth which disrupts the normal physiological functioning of the plant; and 2) losses incurred as a result of physical factors, such as toppling of aged or weakened plants from high flows and burial of young seedlings.

6.2.1 *Physiological Impacts*. Studies cited from the scientific literature and the anecdotal evidence provided by the analog sites reported above suggest that the loss of woody vegetation from direct physiological causes would be minimal since the flooding would most likely occur during periods when plants are dormant or undergoing reduced metabolic activity. Further, the expected flood durations during the dormant season are less than tolerance levels reported in the literature and often considerably less than those reported for growing season tolerances.

6.2.2 *Physical Impacts*. Vegetation loss by physical actions of flooding could occur through a number of mechanisms. As a particular tree species reaches old age or senescence, new root production fails to keep pace with the loss of older roots. Root systems become more vulnerable to invasion by pathogens. In such weakened conditions, trees may be susceptible to uprooting and toppling caused by impact with floating debris, high flow velocities, and/or windthrow before they die from other causes.

Windthrow occurs when strong winds topple trees. It is a fairly common occurrence in forests, but affects mainly diseased or aged trees (Gray and Leiser 1982). Such losses might be accelerated by saturated soils resulting from flooding. It should be noted that when conditions of heavy rainfall occur, rather than snowmelt at higher elevations, the soil in the root zone can be saturated and windthrow can occur without flooding. The percentage of trees lost in this way cannot be estimated without a detailed inventory. However, losses can be expected to be higher in older stands and during the first few flooding events and would be most severe if

windstorms coincide with flooding events. The duration of rainfall events and the subsequent depth of soil saturation might be less than would occur during an inundation event.

Landslides are also a foreseeable consequence of periodic flooding. Slope stability is governed by topographic, geologic, and climatic factors which control the opposing forces of shear stress and shear resistance. Slope movement occurs when shear stresses exceed shear strength, and any variable that increases shear stress or decreases shear strength will tend to induce slope movement. The addition of water to a slope, which has been implicated as a controlling factor in 95 percent of all landslides, contributes to both an increase in shear stress and a decrease in shear strength (Gray and Leiser 1982). Further, shear strengths of the principal soil types found along the North and Middle Forks of the American River (Maymen, Mariposa, Horseshoe, Boomer, Auburn, and Ahwahnee series) are rated as low-to-moderate (U.S. Department of Agriculture 1974).

A recent study conducted by the California Department of Water Resources (DWR) examined the potential for slope failure potentially attributable to operation of a flood control dam in the American River canyon at Auburn (Dudley 1991). Using groundwater models, the study analyzed the ability of the various soil mapping units within the canyon to drain saturated soils. The time differential between the drawdown rate and soil drainage rate, as measured by permeability rates, is termed the phreatic lag. The principal assumption underlying the estimates was that those soils that drained quickly, e.g., short phreatic lags, have greater shear strength due, in part, to increased internal friction when groundwater is at field capacity versus saturation, hence greater shear strength, and less chance for failure. Less permeable soils, however, would have increased shear stresses and would be more prone to slippage. As noted in Section 5.1, the U.S. Forest Service (1965) attributed the principal factor of most slope failure during the 1964 floods in the forests of northwestern California to unstable substrates and bank undercutting.

Based on the soil mapping units and corresponding permeability rates reported by the U.S. Soil Conservation Service (U.S. Department of Agriculture 1974), the DWR report identified approximately 2,600 acres within the flood control reservoir pool in which the drawdown rate exceeded the permeability rate of the soil mapping units and, thus, could be susceptible to slippage. Of the 2,600 acres, about 15 percent, or approximately 400 acres, are composed of Boomer soils which are likely to fail regardless of whether a flood control dam were constructed. Exclusive of the Boomer soils, a net total of 2,200 acres would, therefore, be susceptible to slippage due to dam operations over the life of the project.

Because the DWR analysis used a computer-based groundwater model, the soil binding characteristics of the vegetative root matrix was not factored into the model. On slopes, the vertical root system penetrates through the soil mantle into firmer strata, such as fractured or disintegrated bedrock, and anchors the soil to the slope, thus increasing shear strength and resistance to sliding. The increased shear strength from root permeation is a function of the tensile strength of the roots and the density of the root mass (Gray and Leiser 1984). Studies conducted by Gray and MacDonald (1989) have found that the presence of even shallow root systems (e.g., less than 1-foot in depth) can increase the erosion safety factor 4 times over unvegetated slopes. Therefore, adding an additional component to the DWR slope stability model for vegetative cover and root stabilization would reduce the acreage of canyonlands vulnerable to slippage. For example, in order to determine historic slope failure, the Department of Water Resources, in a separate analysis, planimetered all the slide areas within the inundation zone of the former cofferdam. As a percent of total canyon acreage within the cofferdam inundation zone, the historic slide areas ranged from 0.5 percent in the Middle Fork to approximately 7.1 percent in the North Fork between the confluence and the proposed dam site, and averaged 5 percent for the entire inundation area. A contributing factor responsible for the difference in observed and predicted slope failure is vegetative cover. The five percent landslide figure is also consistent with the landslide acreage estimates of the U.S. Forest Service (1965) on cut-over timberlands following the 1964 floods in northwestern California forests.

Projecting a five percent slope failure rate over the entire 4,000 acre inundation zone would yield a total of 200 acres of land slippage. Based on these two estimates, total land slippage ranges from 200 to 2,200 acres.

Assuming a 50 percent safety factor contributed by vegetative cover and the root matrix, the maximum potential slide acreage yields a total of 1,100 acres vulnerable to failure.

The zones most susceptible to vegetation loss resulting from slope failure would likely vary with the type of failure. With a deep rotational slide, which is most common in the deeper soil mapping units such as the Boomer series, a scarp is created at the top of the slide which is generally stripped of vegetative cover. At the toe of the slide, and depending on the size of the slide, vegetation could be destroyed by physical toppling from mass movement or by smothering of the root system caused by the deposition of materials over the root system. This latter effect would be similar to the impacts experienced by redwood and Douglas fir trees following the floods of 1964 in northwestern California resulting from the deposition of up to four feet of silt at the base of the trees. In contrast, unregulated flood flows would have a much greater tendency to undercut stream banks, and inducing slides from the toe. Trees and shrubs rooted within the slippage, however, generally survive these events. In fact, within the American River canyon, deep slope failures, i.e., below the root zone, entire trees and shrubs have been dislocated intact downslope, as evidenced by the number of "jackstrawed" (canted or tilted) trees found on slide areas. Deep rooted tree species are generally more vulnerable than shrubs to loss in such events. Smaller shrub species may move with the landslide and continue to function if the root systems remain intact and buried, whereas trees may experience root shear if deeper roots are torn off at the plane of failure or abraded against the underlying bedrock. On translational failures, such as shallow debris or avalanche slides, vegetation could be lost through uprooting, toppling, and root shear. These potential impacts must be contrasted with the impacts of unregulated, high velocity flows which have a much higher tendency to induce slippage by undercutting banks. The operation of the flood control dam would reduce high velocity flows.

Soils exposed by such slides may require erosion control treatment and revegetation. Areas of exposed bedrock cannot be revegetated unless there are sufficient pockets of soil, or unless the rock is highly weathered and cracked. Surprisingly good results were obtained by Pacific Gas and Electric Company in revegetating the Lost Canyon washout at the Helms Project by spot seeding, and by using small transplants in cracks in weathered rocks, and exploiting small pockets of soil. Substrate exposed by slides in the American River should be less difficult to revegetate due to milder climate conditions and higher water hold capacity of the canyon soils compared with the decomposed granite soils in Lost Canyon.

Two large rotational failures were examined in some detail. These were located on the right bank, west of the abandoned railroad bridge below the confluence of the North and Middle Forks. These two slides appear to have been active for many years as evidenced by the configuration of the woody vegetation. Both extend above and below the old railroad right-of-way. One showed quite clear evidence of movement between August 1990 and November 1991 by the disruption of the foot trail crossing it on the right-of-way alignment. Numerous small translational failures are visible on the right bank of the Middle fork in thin chaparral-oak scrub. Those slides observed were limited to grass covered areas between the woody vegetation and some were configured around areas of woody vegetation.

6.3 Indirect Losses. Indirect or secondary losses would be those losses at least partially induced by the flooding of the plants. For example, saturated root conditions could potentially increase fungal root diseases, increased insect attack, cankers, etc., and could hasten the loss of vegetation.

6.4 Flooding Effects on Natural Regeneration and Community Succession.

6.4.1 *Regeneration*. The effects of flooding on natural regeneration could be variable. Increased soil moisture during the subsequent growing season could increase growth and survival of seedlings and young plants. Areas subjected to high flow velocities may have soil and seed banks washed away. Soil

disturbances caused by flooding may also bury seeds and improve regeneration. Prolonged inundation is often more harmful to seedlings and young plants than to established plants of the same species. Timing of seed germination and flood events may be such that there are no discernable effects of the flooding on germination and early growth of the plants. In general, however, flooding is most likely to occur in winter after plants set and dispersed seed, and prior to germination.

Becking (1968) reported that following the floods of 1964 in the northwestern California forests, significant increases in the number of redwood seedlings were observed. Along alluvial flats, seedling densities of 80 to 234 seedlings/m^2 compared to densities of 0 to 2.5 seedlings/m^2 on non-flooded sites. Following the subsequent flooding in 1966, Becking reported overall densities of 0 to 12 seedlings/m^2. The greatest mortality of redwood seedlings following the 1966 flood was attributed to drought in the following summer and fall. The greatest mortality occurred to those seedlings that germinated relatively late in the spring.

In Auburn's climatic zone, which has wet winters, dry summers and a highly variable precipitation regime characterized by periods of drought and flooding, the natural regeneration of most woody species is sporadic. Five or more years may elapse between times when a good seed crop and favorable climatic conditions coincide. The probabilities of flooding are also sporadic and random. It is only when these various factors coincide that the flooding may affect natural regeneration. Such events are completely unpredictable.

Based on our observations, the flooding effects on natural regeneration are likely to be insignificant. A field inspection of the North Fork below the old Highway 49 bridge did not reveal any evidence of detrimental effects of previous flooding on natural regeneration. The inspection did indicate both regeneration of common species and establishment of one species (alder) which was scarce or non-existent in the immediate area. Similar results were observed at the reservoirs in the San Gabriel Mountains. Excellent shoot growth was evidenced in several species in the two growing seasons immediately following the 1986 event (Table 2).

At higher elevations in the oak woodland-conifer forest, water velocities at the soil interface should be slight. Little or no loss of seed by water surface fluctuation is expected, since viable seeds of most species have specific gravities greater than 1.0 and do not readily float away. Some surface disturbance and sediment deposition could be beneficial by lightly burying seed. Increased soil moisture would be beneficial for seed germination and plant growth. The culmination or coincidence of these events is unpredictable, but it is not improbable that beneficial effects could offset detrimental effects.

6.4.2 *Community Succession*. In an attempt to predict the consequences of periodic flooding on the long-term vegetation patterns in the American River canyon, we have adopted the view that ecological systems are always in a state of flux. As noted out by Holling et al. (1978, p35):

> *"The traditional paradigm of ecological evaluation often is that the world is or should be designed to be static or constant. But when that leads to a goal of ecological or environmental "purity" or constancy, it can no longer be labeled ecologically sound. Ecological systems are dirty, changing, growing, and declining. That is the source of their resilience and diversity (emphasis added)."*

In this analysis, we have considered the probable conditions in the project area in the 1850s, the conditions at the current time, and some impacts that have occurred in the recent past. Based on this information, we have attempted to estimate potential changes that may occur in the area with the proposed project. Estimates of the impacts of the Auburn flood control dam on the canyon vegetation requires either baseline information of the impact area or assumptions regarding the recent history of the project area.

The immediate past history of vegetation of the area has probably been modified compared to the history a century or more ago. Fowells (1965) states in the chapter on ponderosa pine:

"Some observers feel that, because of organized fire protection, a natural thinning process has disappeared and as a result, dense, even aged, stagnating stands of the species have developed. Furthermore, the invasion of associated species...have crowded out the advanced reproduction and weakened the overstory of ponderosa pine, making it a prey for insects. Also when fire is excluded brush appears to invade at the expense of grass. Others believe that past fires have been instrumental in prompting the typical group appearance of small even-aged stands in this species."

Although this passage referred to more pure stands of ponderosa pine rather than the mixed woodlands of the project area, the assumptions about the invasion of brush and the suppression of the regeneration appear to be reasonable for this mixed foothill woodland. Limited losses of the rather dense community would provide openings and the opportunity for regeneration, thus providing a mix of older and younger plant communities.

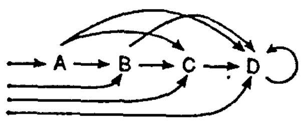
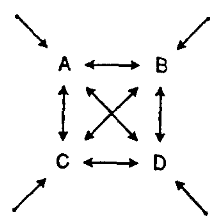
Fire does occur in the area and the consensus of foresters appears to be that fire severity is greatly increased because of a half century or more of brush accumulation. Where natural fire or controlled burns are used to minimize the accumulation of fuels mature trees will frequently survive periodic burning. Undoubtedly the present habitat is altered from that of as recently as one hundred years ago as a result of fire suppression and greater severity of damage when fire does occur due to the build up of fuel.

An understanding of the potential successional patterns of vegetation in the project area is important in any estimate or prediction regarding the consequences of the operation of the dry dam, e.g., what vegetation will replace vegetation that might be lost due to operations? The simplistic description of succession -- that after disturbance an area is invaded successively by pioneer species (often annuals), then a series of later successional species until a community attains a sub-climax or climax stage -- does not accurately describe what usually occurs. A number of models are now recognized for plant succession. Kozlowski et al (1991) summarize a three model mechanism advanced by Connell and Slatyer (1977, in Kozlowski et al. 1991) and six successional replacement sequences proposed by a number of investigators (Figure 15).

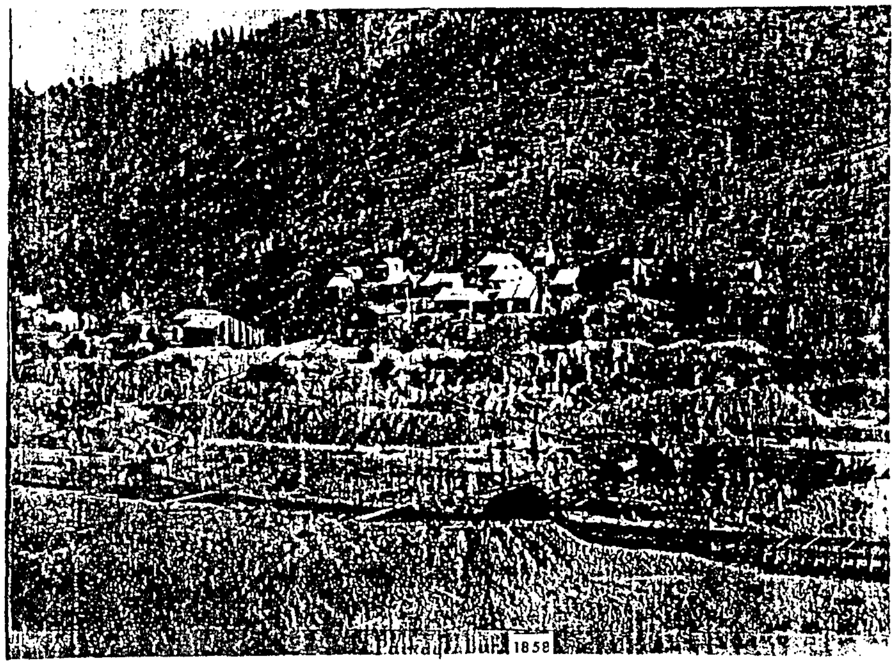
The straight line model assumes that after every disturbance recolonization begins with pioneer species and proceeds through a series of vegetation types to a sub-climax or climax community. This sequence has been termed "classical", "facilitation", "replacement", "obligate", or "relay floristics" by various investigators. However, observations of disturbances in the project area, and comparison of 1850 and 1970 era photographs (discussed below), suggest that some of the other models may better describe the regeneration and the successional sequence that occurs in the American River canyon. Vegetation in a number of disturbed areas, landslide areas, at the former gravel operation, roadside cuts and fills and in the riparian zone indicate that after disturbance, the regeneration does not always begin with the annual pioneer or ruderal species. Two patterns suggested by Connell and Slatyer, "Tolerance" and "Inhibition" and two of those suggested by Whittaker and Levin (1977, in Kozlowski et al. 1991), "Plateau" and "Chronic Disturbance" appear to much better describe the regeneration seen in the photographic comparisons of the Middle Fork between 1858 and 1977 by Turner (1983).

Although baseline studies are not available for this area, the series of photographs made of gold mining operations on the Middle Fork in the 1850's with comparison photographs from 1977 provide a picture of quite a different vegetation cover than now occupies the area. The series includes comparisons from 17 locations; however, 4 comparisons were considered most representative. These include photographs at Hoosier Bar (formerly Hossins or Package Bar, Figure 16a,b), Maine Bar (formerly Cranwillie's Claim, Figure 17a,b), and Poverty Bar (Figures 18a,b, and 19a,b). Some assumptions about the status of the existing vegetation patterns, the reproductive ecology of the vegetation, and the responses of the vegetation to certain disturbances can be made by observing the changes between then and now.

Successional/Replacement Sequences

	Theory				
Model[b]	Clements	Connell and Slatyer	Whittaker and Levin	Horn	Egler
→ A → B → C → D ↺	Classical	Facilitation	Replacement	Obligate	Relay floristics
		Tolerance		Competitive hierarchy	
→ A ↺ B → C → D ↺		Inhibition	Plateau		
→ A ↺			Direct		
			Chronic disturbance		
→ A → B → C → D ↺ bcd cd d d					Initial floristic composition

[a] From Noble, 1981.
[b] The letters represent hypothetical dominant species; uppercase letters indicate dominance and lowercase letters indicate subdominance. The arrows marked with a dot show alternative starting points for the replacement sequence after a disturbance.



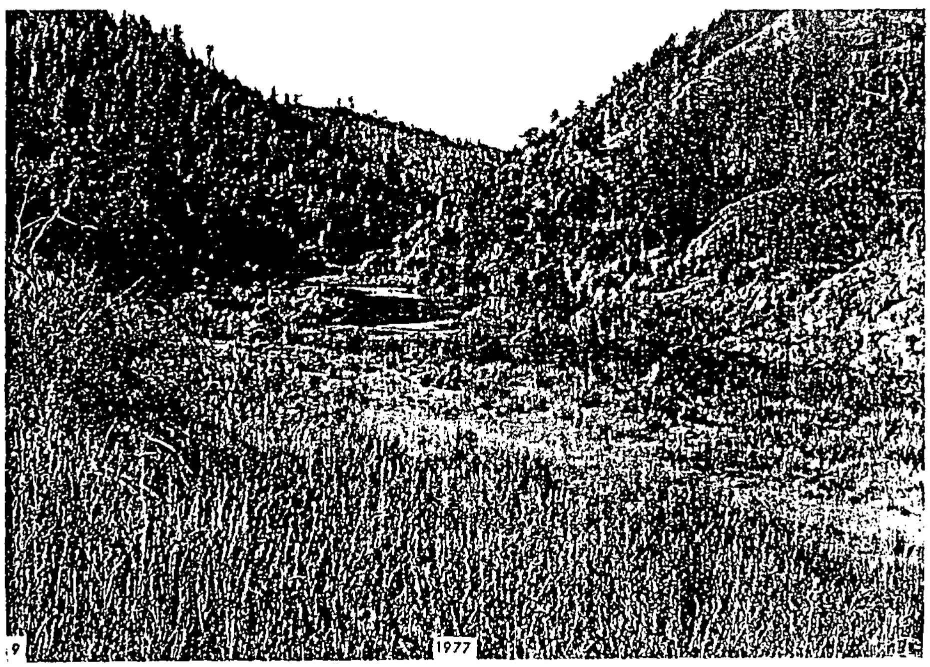
A. Hoosier Bar (formerly Package Bar) in 1858 near RM 27.2 on the Middle Fork of the American River.

B. Hoosier Bar in 1977.

Source: Turner (1983)

FIGURE 16

A. Maine Bar (formerly Cranvillie's Claim) in 1858 near RM 28.7 on the Middle Fork of the American River.

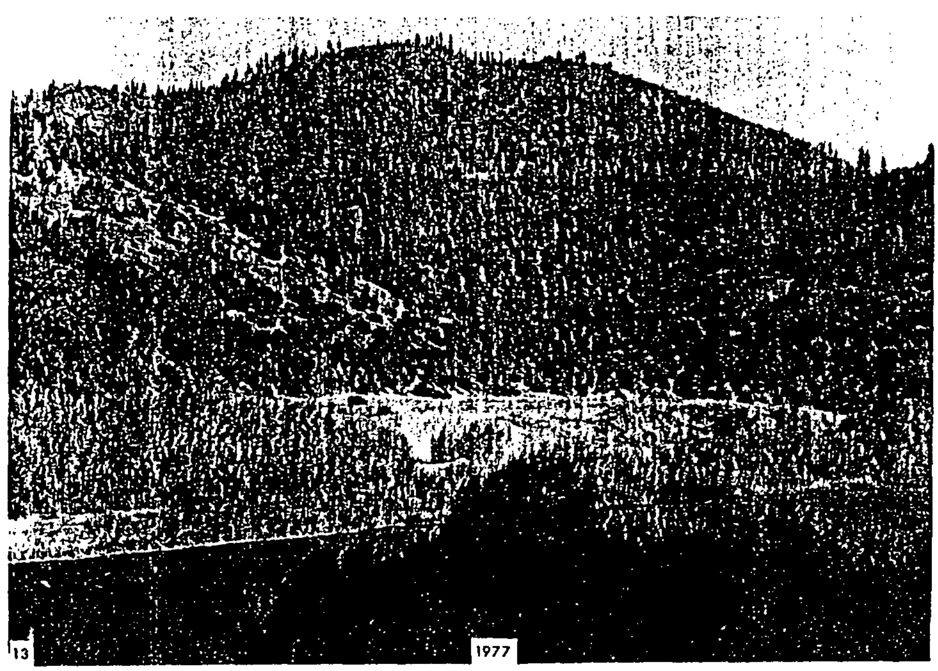


B. Maine Bar in 1977.

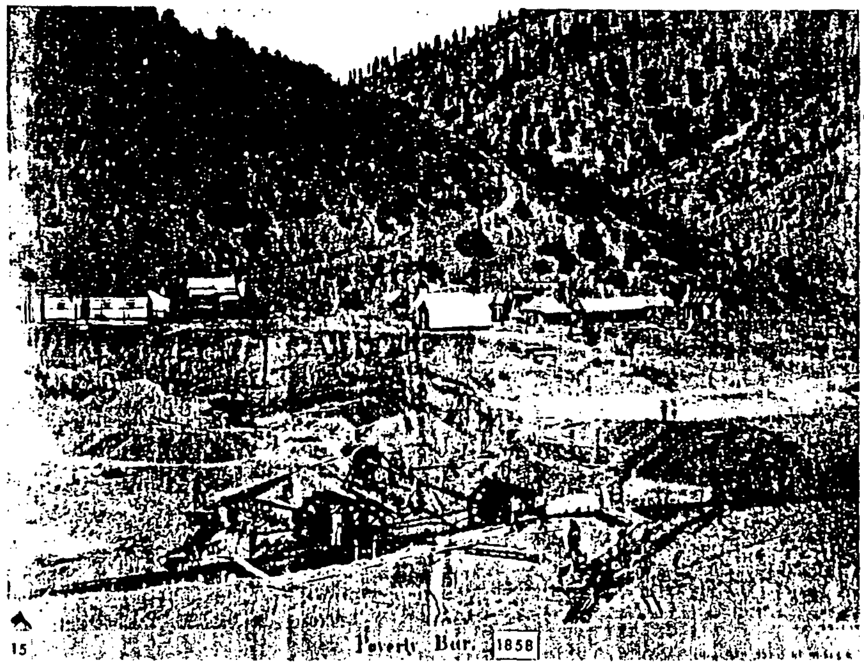
Source: Turner (1983)

FIGURE 17

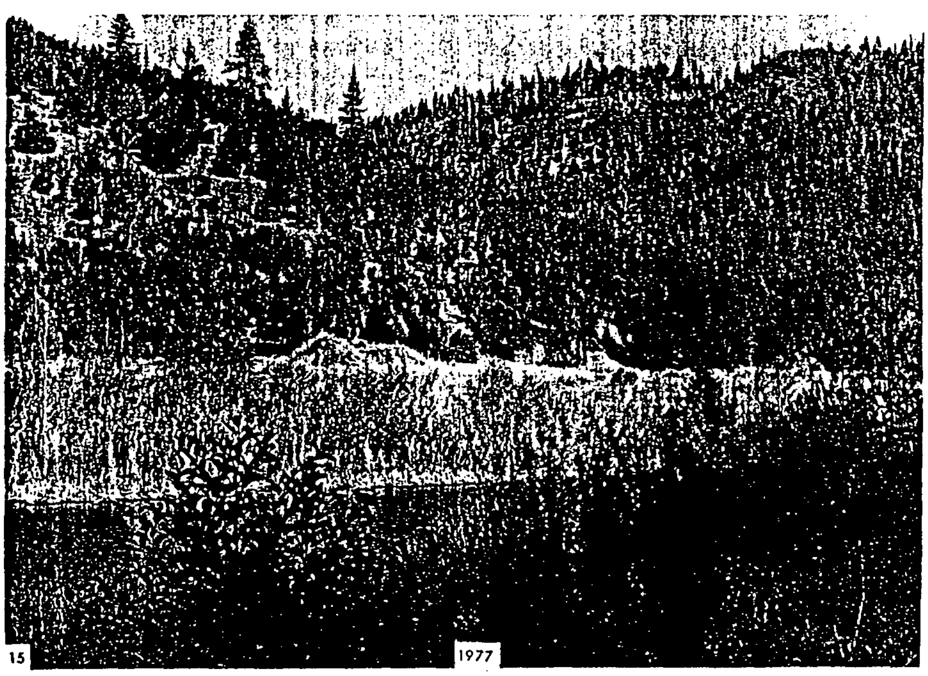
A. Poverty Bar in 1858 near RM 29.5 on the Middle Fork of the American River.



B. Poverty Bar in 1977.



A. Poverty Bar in 1858 near the Middle Fork of the American River.



B. Poverty Bar in 1977.

Source: Turner (1983)

FIGURE 19

The 1850 era photographs reveal that the plant communities were probably subjected to repeated fires. Some of the lack of tree cover may have been due logging for houses, sluices and other mining structures, however, it is more likely that the settlers used the pines from higher elevations for these structures because they were more easily milled. The principal oak species (blue, valley, black, and interior live oak) were used mostly for fuel or fence posts due to the bulk, susceptibility to rot, and knotty character of the lumber (Peattie 1953). An exception was the canyon live oak which was used for a variety of tools. In most of the photographs there are no signs of logging disturbances. Skid trails, slash, stumps and other signs of logging activity are not visible. The predominate vegetation community appears to be an open chaparral with shrubs, or clumps of shrubs, rather well separated much as oaks are spaced in a savanna community. Some of these areas may, in fact, be oak woodland that has resprouted after fire. In spots, the chaparral is rather dense as we see it today. The pattern appears to be essentially identical to areas we see today where existing chaparral has been burned at more or less regular intervals.

Other vegetation includes the riparian community and small amounts of the typical foothill woodland (Munz and Keck 1968) with perhaps some ponderosa pine. Some of these areas may also be oak woodland communities, but it is difficult to determine any boundaries because of the quality of the reproductions. The riparian community appears largely disrupted by the mining activities and only remnant vegetation remains. The foothill woodland is limited in extent and generally confined to draws and the higher elevations of the canyon. It is more extensive on the northerly facing slopes (left bank of the river) than on south facing slopes as would be expected in this climatic zone. The sparse nature of the foothill woodland and the presence of a few large trees and trees of much younger age classes also suggests a community subject to recurring fires.

Comparison of these photographs provides evidence of the potential for recruitment and revegetation in the American River canyon. The sparse foothill woodland has become a dense woodland and has reoccupied some of the territory that appeared to be scrub or chaparral area in the original photographs. The chaparral has changed from a sparse open stand to very dense stands and the riparian community is thriving. It is reasonable to assume that similar regeneration will occur on areas subject to disturbance in the future. Only a "worst case scenario" should assume the "Classical" model of succession. Evidence in the project area indicates that in many cases the "worst case scenario" has not occurred in the recent past. A more reasonable assumption for evaluation of the potential effects of the operation of a dry dam with infrequent flooding should be based on some estimate of the probability of how the expected small, scattered areas of disturbance will regenerate. It is expected that areas adversely impacted by inundation will result in scattered openings within the inundation zone.

The potential losses that might occur from all causes may be expected to be distributed randomly throughout the project area. With the exception of the vegetation lost due to earth movement (slides, slippage), the majority of the losses expected are among the older or weakened trees and shrubs and those individuals growing in marginal microsites. The end result is that there will be some acceleration in the normal cycling and successional patterns of the various plant communities over a relatively long period. These changes are not likely to be sudden and dramatic as are those caused by fire, but very gradual and largely imperceptible. Communities with mixed age-classes and high species diversity are generally considered desirable attributes.

Without dramatic climatic changes, these areas will revegetate to cover types and species compatible with existing seed sources, and in cases of vegetative propagation, compatible with existing parental stock. In areas subject to landsliding, two potential changes are likely. First, along higher elevation scarps, portions of the soil mantle will be removed or reduced, shifting vegetation from those species adapted to thick soils, such as oak woodland species, to those species adapted to thin soils, such as species within the chaparral or grassland communities. Second, along the toe of the canyon slopes were mass movement will increase the soil depth, the thicker soils and higher soil moisture conditions resulting from more frequent flooding will favor expansion of the riparian corridor. However, without other influences, such as fire, more prolonged drought periods, disease, etc., these changes are expected to be scattered, and sudden large-scale vegetation changes are not expected.

6.5 Estimate of Total Vegetation Loss. Based on the data derived from the literature and on observations of analog sites, it was assumed that minimal losses would occur from flooding of dormant vegetation or vegetation undergoing decreased physiological activity. There are, however, taxa for which data are absent, but it was assumed that tolerances for those species and genera will be similar to the tolerances of other species in the same community due to similar adaptive strategies to the existent environmental conditions. This assumption is borne out by personal observations of the survival of several species which were inundated during previous floods. Therefore, in an effort to quantify these losses, an analytical framework was developed. Given the lack of empirical data, and other uncertainties discussed in Section 7, assumptions and conclusions may be subject to different interpretations based on personal experience and professional judgement. However, the inundation mortality estimates are predicated on the following baseline information and assumptions:

1) *the revised Elevation-Duration-Exceedence Frequency curve for the 200-year flood control dam indicates that within a 100-year period of analysis a 7-day inundation event would occur on approximately 9 occasions to elevation 520 feet, msl; to elevation 550 feet on 3 occasions; to elevation 600 feet on 1.4 occasions; to elevation 650 feet on 0.9 occasions; and to elevation 750 feet on 0.2 occasions (see Table 8 and Figure 20). The elevation band below the 530-foot contour was eliminated from the analysis because this zone would be subject to inundation and scour for durations exceeding 7 days during an unregulated 100-year storm event. The number of flood events was determined for the different elevation bands on the basis of the 7-day flood event at the midpoint of the band using Figure 20. For example, the midpoint of the band between elevations 500 and 530 feet is 515 feet, and the number of inundation events during the 100-year period of analysis corresponding to the 7-day event was determined to be approximately 10 events. The number of events in which flood waters would encroach into the 720-880 foot elevation band would be less than 0.2 events. An additional flood event was added to each elevation band, even if the occurrence was estimated to be less than 1.0. Consequently, vegetation mortality estimates for the 530-580 foot elevation band was based on 4 events; the 580-640 foot elevation band was based on 3 events; and the 640-720 and 720-880 elevation bands were based on 1 event.*

2) *vegetation was separated into seven cover type categories (south slope oak woodland, north slope oak woodland, chaparral, conifer forest, rocky ruderal, grassland, and montane riverine within the discrete elevation bands described above. The vegetation categories and corresponding cover type acreage within elevation bands were determined by field surveys conducted by the U.S. Fish and Wildlife Service (1991) and the U.S. Army Corps of Engineers (Table 9), and from the Area-Capacity curve for the proposed flood control reservoir.*

3) *the montane riverine vegetation, composed of palustrine forested wetlands (PFO), palustrine shrub-scrub wetlands (PSS), and palustrine emergent wetlands (PEM), and grassland vegetation were assumed to not experience significant mortality resulting from periodic inundation. Riparian vegetation is adapted both physiologically and physically to very prolonged flooding (Table 3). Any grassland vegetation adversely affected by flooding is assumed to recover within the next growing season due to the annual growth strategies of the predominant species in the area.*

4) *a baseline mortality threshold of seven days of inundation during the non-growing season was established. This threshold was based on the review of scientific literature summarized in Table 3 and observational data from the analog sites. This duration accounts for only direct physiological impairment or death. Physical impacts are largely independent of duration and could, therefore, occur at shorter durations. For instance, the time necessary to saturate soils to the point that would induce slope failures could be less than a few days.*

5) *following a 7-day inundation, it was estimated that approximately 15 percent of the vegetation within each elevation band would be killed. This mortality factor is based on two considerations. First, those individuals most vulnerable to flooding impacts are the young, old, and genetically*

inferior. It was assumed that within a normally distributed population, the total percentage of these vulnerable individuals would be 15 percent, e.g., the sum of the 2 "tails" of the normal curve. The second factor considered in establishing a 15 percent mortality factor was based on the in a flood tolerance study of Douglas fir seedlings conducted by Minore (1968, in Walters et al. 1980b), seedlings subjected to total submergence during the dormant season experienced a 15 percent mortality after 14 days. The use of this factor to the American River site was considered applicable for the following reasons: a) the data were derived from flood treatments on seedlings which are more susceptible to physiological damage than are older plants; b) the treatments included total submergence rather than shallow flooding of the root crown; c) the treatments were conducted during the dormant season which is the likely timing of flooding in the American River canyon d); and, because Douglas fir is categorized as an Intermediately Tolerant species (Walters et al. 1980a,b; Chapman et al. 1982), the 15 percent mortality would roughly represent an average loss among the American River canyon communities -- less tolerant species may sustain greater damage, while more tolerant species would be expected to incur less damage.

6) an estimated loss of between 200 and 1,100 acres of vegetation was attributed to physical impacts related to slope failure. Because of the inability to accurately predict landslide areas and corresponding vegetative cover, the estimate of cover type loss was pro rated on the basis of the total vegetated acreage, by cover type, in the total inundation zone. This, therefore, included the loss of riparian species which could be lost as a result of mass movement and smothering. The predicted loss of vegetation from slope instability is very likely much higher than would actually occur. This is due to the following factors: a) historic slides in the canyon and reported in the literature at other sites have been less than 5 percent of the area subjected to flooding. The 1,100 acre figure represents 23 percent of the total inundation area; and, b) the 1,100 acres figure also represents a total loss of vegetation when, in fact, vegetation loss on historic slides were generally confined to the scarp above the slide and the area at the slope toe covered by debris. The remaining vegetation generally survives intact. Because the scarp and toe areas are small proportions of a slide mass, the 1,100 acres represents a greater loss than would probably occur.

7) with regards to the level of winter activity (cambial growth and photosynthesis) for certain chaparral species, the available evidence does not indicate that occasional short-term flooding will cause serious problems. Ample soil moisture may actually increase photosynthetic activity (Hanes 1965). It was, nonetheless, assumed, that the entire chamise-dominated chaparral component within each band would be lost after a period of inundation exceeding seven days. This assumption was based on three factors: 1) certain chaparral species may actively grow during periods of potential inundation; 2) there is uncertainty concerning the growing season flood tolerance of certain chaparral species; and 3) a conservative evaluation is prudent, given the level of uncertainty.

8) the analysis considered potential beneficial effects on vegetation that could be realized with periodic inundation, such as expansion of the riparian zone and increased seed germination. However, the potential benefits were not subtracted from the loss estimates. Therefore, the loss estimate represents a more conservative estimate.

9) regeneration of areas denuded of vegetation as a result of inundation losses is likely to follow three different successional sequences depending on cause of mortality and location of impact. In areas where individual plants are lost a direct successional sequence, wherein dominant species reestablish directly after a disturbance without intervening seres, is likely due to the prevalence of seeds and dormant rootstocks of the dominant species. In situations where slope instability results in the striping of vegetation from an area, a classical or replacement successional sequence may be favored due to reduced soil depths. At lower elevations, particularly at the base of slopes and adjacent to the river, it is likely that increases in soil depths from mass movement and increases

in soil moisture from more frequent and higher elevation inundation, coupled with decreased channel scour would expand the riparian zone and favor an inhibition sequence. Because of the lack of any experimental evidence, no quantitative estimate of the change in the relative proportions of the cover types is possible.

Based on these assumptions, it is estimated that a cumulative loss of approximately 605 acres could occur over the 100-year period of analysis as a result of direct physiological loss (Table 9). An additional loss of between 200 and 1,100 acres could potentially result from slope failures induced by periodic inundation (Table 10). Consequently, the estimated vegetation losses resulting from operation of the flood control dam range from 800 to 1,700 acres (Table 11). Actual losses are expected to be less due to the fact that flooding would occur when most plants are physiologically inactive or dormant, and not all vegetation on landslides will be destroyed. However, because of the lack of specific information on certain species inhabiting the canyon, (chamise, for example), and uncertainty concerning inundation recurrence intervals, slope stabilities, plant vigor, etc., it was deemed prudent to overestimate losses.

7.0 UNCERTAINTY

7.1 Background. Unlike the typical reservoir situation in which all terrestrial vegetation is lost as a result of permanent inundation, predicting vegetation losses within an intermittently inundated flood control reservoir poses several areas of uncertainty. The uncertainty stems from the lack of definitive pilot studies of flood tolerances of vegetation within the American River canyon and reliance on generic studies of flood tolerance, observations from analog sites, and professional judgements.

In situations where reliable predictions of ecological effects of a project or action are not feasible, even with extensive field investigations, Paine (1981, in Orians 1986) recommends that planners, decisionmakers, and managers be appraised of the limits of predictive ability so proper consideration is given to the uncertainty of the ecological consequences.

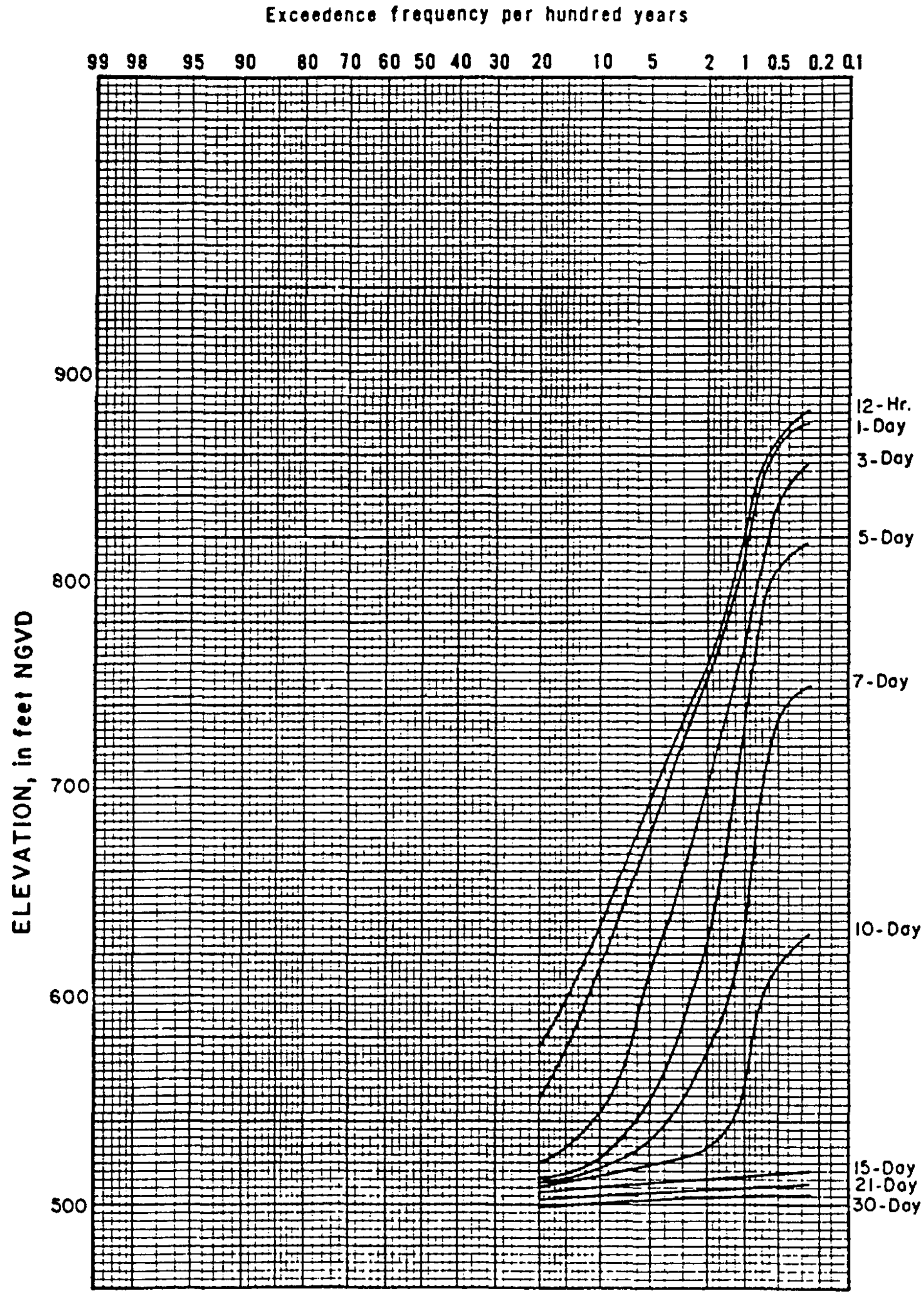
In formulating the national policy for the environment, Congress acknowledged that all risk could not possibly be eliminated from the decisionmaking process, that civilization had advanced by taking such risks, and that risks must continue to be taken despite a lack of complete foreknowledge of the consequences of many activities (Council on Environmental Quality 1990). In addressing the issue of uncertainty in environmental impact analyses, the Council on Environmental Quality revised Section 1502.22 of the National Environmental Policy Act (NEPA) in 1986. In situations where uncertainty exists concerning future environmental impacts, and the costs of obtaining information necessary for evaluating significant impacts is costly or beyond state-of-the-art, the regulations require analysis of "reasonable foreseeable" impacts, which replaced the former "worst-case analysis" standard (Weiss 1988; Cohrssen and Covello 1989). "Reasonably foreseeable impacts" include those impacts which may have catastrophic consequences, even if their probability of occurrence is low, provided they have credible scientific support, are not based on pure conjecture, are within the rule of reason, and are based upon theoretical approaches or research methods generally accepted in the scientific community (Council on Environmental Quality 1990).

The California Environmental Quality Act guidelines (Sections 15144-15145) also address the issue of uncertainty. The guidelines acknowledge that although *"foreseeing the unforeseeable is not possible"* agencies are required to find out and disclose that information that it can do in a reasonable manner (California Office of Planning and Research 1986).

TABLE 8.
ELEVATION-DURATION-EXCEEDENCE FREQUENCY (100 YEARS) FOR THE PROPOSED 200-YEAR FLOOD CONTROL DAM AT AUBURN

		1-DAY INUNDATION	3-DAY INUNDATION	7-DAY INUNDATION	10-DAY INUNDATION
MONTH	ELEVATION	EXCEEDENCE FREQUENCY			
DEC-FEB	870	0.40			
	850	0.70	0.33		
	800	0.90	0.75		
	750	1.50	0.98	0.20	
	700	2.95	1.40	0.70	
	650	5.10	2.35	0.90	
	600	8.30	4.00	1.20	0.70
	550	12.25	6.10	2.10	1.05
	520	37.00	10.90	6.50	3.45
MAR-SEP	800	0.20			
	750	0.35	0.20		
	700	0.65	0.35		
	650	1.30	0.55		
	600	2.50	1.00	0.20	
	550	6.53	2.00	0.55	
	520	23.50	6.45	1.80	0.65
OCT-NOV	750	0.25			
	700	0.40	0.25		
	650	0.60	0.40		
	600	1.20	0.60		
	550	2.40	1.00	0.35	
	520	6.50	2.65	0.70	0.40
TOTAL	870	0.40			
	850	0.70	0.33		
	800	1.10	0.75		
	750	2.10	1.20	0.20	
	700	4.00	2.00	0.70	
	650	7.00	3.30	0.90	
	600	12.00	5.60	1.40	0.70
	550	21.00	9.10	3.00	1.05
	520	67.00	20.00	9.00	4.50

Source: U.S. Army Corps of Engineers (1991)



NOTES:
1. Dam located at River Mile 20.1 designed to control a 200-Yr. flood with 400,000 ac.-ft. of flood control space in Folsom Lake and a 115,000 cfs objective release.
2. Top of inactive pool - elevation 490.
3. Curves define the duration of time elevation is equalled or exceeded.

ELEVATION-FREQUENCY-DURATION
AUBURN DRY DAM ALTERNATIVE
(200-YEAR DESIGN)

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO, DISTRICT

Source: U.S. Army Corps of Engineers

FIGURE 20

TABLE 9.
ESTIMATED LOSS OF VEGETATION THROUGH PHYSIOLOGICAL IMPAIRMENT FROM PERIODIC INUNDATION BY THE PROPOSED FLOOD CONTROL DAM AT AUBURN, CA.

		FLOOD EVENT											
ELEVATION	COVER TYPE	BASE	1	2	3	4	5	6	7	8	9	10	LOST ACRES
		Cover Type Acreage Remaining After Successive Floods[1]											
500-530	So. Oak Woodland	15	13	11	9	8	7	6	5	4	3	3	12
	No. Oak Woodland	15	13	11	9	8	7	6	5	4	3	3	12
	Chaparral[2]	7	0	0	0	0	0	0	0	0	0	0	7
	Conifer Forest	3	3	2	2	2	1	1	1	1	1	1	2
	Riverine	58	58	58	58	58	58	58	58	58	58	58	0
Subtotal 1		98	86	82	78	75	73	70	69	67	66	64	34
530-580	So. Oak Woodland	37	31	27	23	19							18
	No. Oak Woodland	48	41	35	29	25							23
	Chaparral	7	0	0	0	0							7
	Conifer Forest	3	3	2	2	2							1
	Riverine	59	59	59	59	59							0
Subtotal 2		154	134	123	113	105							49
580-640	So. Oak Woodland	94	80	68									26
	No. Oak Woodland	98	83	71									27
	Chaparral	8	0	0									8
	Conifer Forest	8	7	6									2
	Riverine	161	161	161									0
Subtotal 3		369	331	306									64
640-720	So. Oak Woodland	248	211										37
	No. Oak Woodland	257	218										39
	Chaparral	27	0										27
	Conifer Forest	27	23										4
	Riverine	274	274										0
Subtotal 4		833	726										107
720-880	So. Oak Woodland	819	696										123
	No. Oak Woodland	771	655										116
	Chaparral	121	0										121
	Conifer Forest	169	144										25
	Riverine	410	410										0
Subtotal 5		2290	1905										385
TOTAL		3744	3182										639

[1]Assumes a 15 percent mortality per flood event
[2]Assumes a total loss of chamise-dominated chaparral

TABLE 10.
ESTIMATED LOSS OF VEGETATION FROM SLOPE INSTABILITY RESULTING FROM PERIODIC INUNDATION OF THE PROPOSED FLOOD CONTROL DAM AT AUBURN, CA.

	ELEVATION BANDS						
COVER TYPE	490-530	530-580	580-640	640-720	720-880	TOTAL ACREAGE	PERCENT TOTAL
Grassland	9	7	16	18	48	98	2
Rocky/Ruderal	8	7	25	35	72	147	4
South Slope Oak Woodland	15	37	94	248	819	1,213	30
North Slope Oak Woodland	15	48	98	257	771	1,189	30
Chaparral	7	7	8	27	121	170	4
Conifer Forest	3	3	8	27	169	210	5
Montane Riverine	58	59	161	274	410	962	24
TOTAL	115	168	410	886	2,410	3,989	100

TABLE 11.
ESTIMATED LOSS OF VEGETATION FROM PHYSIOLOGICAL EFFECTS AND SLOPE INSTABILITY RESULTING FROM PERIODIC INUNDATION OF THE PROPOSED FLOOD CONTROL DAM AT AUBURN, CA.

COVER TYPE	PHYSIOLOGICAL LOSSES	SLOPE INSTABILITY LOSSES	TOTAL
Grassland	-	22	22
Rocky/Ruderal	-	-	-
South Slope Oak Woodland	204	330	534
North Slope Oak Woodland	205	330	535
Chaparral	163	-	163
Conifer Forest	32	55	87
Montane Riverine	-	264	264
TOTAL	604	1,045	1,605

7.2 Areas of Uncertainty. Based on initial report findings, review of the scientific literature, and subsequent technical review meetings, the following areas of uncertainty were identified:

1) *lack of empirical data from controlled field and/or laboratory studies for some species;*
2) *applicability of analog sites;*
3) *predictability of flood recurrence intervals;*
4) *timing of the onset of the growing season for certain species;*
5) *age and vigor of individuals and stands of vegetation;*
6) *ecotypic and genetic variation among and between species; and,*
7) *size, location, and plant cover on landslide areas;*
8) *post-inundation regeneration rates and successional patterns.*

The consequences associated with the uncertainty identified above are potentially greater or reduced vegetative losses, or modifications within the existing plant communities than predicted by the impact analysis in Section 6.4.

Orians (1986) cautions on the dependence on analog studies because variability in physical and ecological conditions can lead to errors in extrapolating effects between or among sites. Further, even with definitive pilot studies of the American River plant communities, projecting impacts of periodic inundation can suffer from inaccuracies because ecological systems respond to perturbations in site-specific fashions, and that large or novel perturbations can produce effects not predictable from basic ecological principals. Additionally, Holling (1978) maintained that such assessments cannot be predictions in any real sense for two primary reasons. First, not all variables can be measured. And, second, no amount of observation prior to a project will reveal what impacts a project will eventually have since the impacts will be consequences of disturbances that are unlike any the natural system has yet experienced.

Consequently, on the basis of the uncertainties inherent in the prediction of impacts associated with the vegetation losses from periodic inundation, a two-phase mitigation program is recommended. Phase one would address predicted vegetation losses through implementation of an upfront acquisition of mitigation lands. Phase two would address any future losses in excess of those predicted in this report.

8.0 MITIGATION

8.1 Background. Canter et al. (1991) note that the perception that mitigation is simply an unnecessary add-on cost should be dispelled. Although up-front mitigation may be costly, it is more cost-effective than adopting a more costly clean-up program at some future point in time. This is particularly true for large federal projects with long periods to secure post-project mitigation authorization and appropriation. In the intervening period, environmental values are lost, while costs associated with planning, design, remobilization of the work force, etc., increase.

The federal regulations promulgated by the Council on Environmental Quality (1978) for implementing the National Environmental Policy Act (40 CFR 1502.14(f)), as well as the California Environmental Quality Act guidelines (Section 15126(c)) require that agencies identify feasible mitigation measures that could minimize significant adverse impacts of a project (Council on Environmental Quality 1978; California Office of Planning and Research 1986). Both authorities define mitigation as:

1) *Avoiding the impact altogether by not taking a certain action or parts of an action;*
2) *Minimizing impacts by limiting the degree or magnitude of the action and its implementation;*
3) *Rectifying the impact by repairing, rehabilitating, or restoring the affected environment;*

4) *Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and,*

5) *Compensating for the impact by replacing or providing substitute resource or environments.*

While NEPA does not require the adoption of mitigation measures by federal agencies (Mandelker 1989), CEQA prohibits public agencies from approving or implementing a project for which significant impacts have been identified unless:

1) *Changes or alterations have been required in, or incorporated into, the project which avoid or substantially lessen the significant environmental effect as identified in the final EIR (California Public Resources Code Section 15091(a)(1));*

2) *Such changes or alterations are within the responsibility and jurisdiction of another public agency and not the agency making the finding. Such changes have been adopted by such other agency or can and should be adopted by such other agency (Section 15091(a)(2));*

3) *Specific economic, social, or other considerations make infeasible the mitigation measures or project alternatives identified in the final EIR (Section 15091(a)(3)).*

Rather than attempting to mitigate for all conceivable impacts, including those with low probabilities of occurrence, such as a total loss of vegetation in the canyon, a plausible mitigation program should be formulated to address credible impact estimates based on existing scientific evidence, while recognizing that uncertainty will require long-term monitoring and possible future adjustment of mitigation acreage if actual impacts exceed estimates.

Therefore, a mitigation program should include a combination of up-front mitigation and a post-flood remediation program to provide a prudent and economically sound method for best assuring the continued maintenance of canyon vegetation and habitat values.

8.2 <u>Up-Front Mitigation</u>. It is estimated that approximately 605 acres of vegetation could be lost during the 100-year life of the project, and between 200 and 1,100 acres of additional vegetation could be lost through slope failure. A mitigation plan involving the acquisition of suitable lands and acreage should be implemented to compensate for potential losses resulting from operation of the flood control dam.

8.3 <u>Post-Flood Remediation</u>. The Post-Flood Remediation Plan should include a program to monitor the effectiveness of the up-front mitigation measures, and to monitoring the effects of flooding on canyon vegetation.

8.3.1 ***Mitigation Monitoring.*** Holling (1978) has recommended that the major change required to shift environmental assessment from its traditional role of impact description into meaningful environmental management is the continuation of assessment activities (monitoring) during and after the period of construction. Post-EIS monitoring can aid in the evaluation of the effectiveness of mitigation measures and identification of any unanticipated impacts resulting from uncertainty in pre-project assessments (Canter et al. 1978).

Mitigation monitoring is a requirement of both NEPA and CEQA. Under NEPA regulations, agencies are required to adopt monitoring and enforcement programs for any mitigation (40 CFR 1505.2(c). Under Section 40 CFR 1503, CEQ states that "agencies may provide for monitoring to assure that their decisions are carried out and should do so in important cases. Mitigation (1505.2(c)) and other conditions established in the environmental impact statement or during its review and committed as part of the decision shall be implemented by the lead agency or other appropriate consenting agency. The lead agency shall: (a) include appropriate conditions in grants, permits or other approvals; (b) condition funding of actions on mitigation; (c) upon request, inform cooperating or commenting agencies on progress in carrying out mitigation measures which they have

proposed and which were adopted by the agency making the decision; and, (d) upon request, make available to the public the results of relevant monitoring.

Section 21081.6 of the California Public Resources Code requires public agencies to adopt a reporting or monitoring program whenever the agencies adopt CEQA findings that significant impacts will be mitigation to less than significant impacts, or adopt a negative declaration which incorporates mitigation measures (Silva 1991).

Implementation of mitigation monitoring is also recommended under U.S. Army Corps of Engineers Planning Guidance. Specifically, Section 7-35(j) of the Corps' planning guidance manual states that, "monitoring is appropriate for major mitigation actions when new, unproven management techniques are being applied, and when significant levels of risk and uncertainty prevail at the time of implementation. The district commander shall include the cost of a monitoring program in the estimate of O&M cost for fish and wildlife mitigation measures, if such a program has been adopted in accordance with 40 CFR part 1505.2(c) and 1505.3" (U.S. Army Corps of Engineers 1989).

8.3.2 *Adaptive Management Program*. In the event that future floods impact vegetation in excess of that provided by the up-front mitigation, a post-flooding remediation program should be implemented to accurately assess, and cost-effectively replace lost vegetation.

The method presently recommended by the National Academy of Science for dealing with the issue of uncertainty in projecting ecological effects of a project is the implementation of adaptive management strategies (Johnston and McCartney 1991; Orians 1986). As noted by Holling (1978) and Hilborn et al. (1980), adaptive management is essentially using the project itself as an experiment probe to examine those impacts not readily or reliably estimated or predicted using convention pre-project study techniques. Viewing a project or action as an experiment can aid in designing a program to monitor effects. Such impact monitoring, as opposed to mitigation monitoring described above, can have three major advantages. These include the following:

1) *detection of unexpected effects can be used as a basis for altering or adjusting procedures.*
2) *monitoring provides continuous indexes that can signal environmental degradation or improvement.*
3) *impact monitoring information can be used in the planning and design or similar projects or actions (Holling 1978).*

With respect to item 3 above, Whitlow and Harris (1979) have noted that, *"there is sufficient research to date to permit a first approximate rating of both native U.S. and introduced plants according to flood tolerance. What is required now, rather than continued screening of large numbers of species, is a detailed evaluation of the performance of previously studied species under a variety of circumstances. The aim should be to produce a refined rate scheme that will focus on regional needs and specific plants to meet those needs. Important in this endeavor will be the description of ecotypic variation so that cultivars may be selected on the basis of desirable traits. An ideal opportunity is here to join practical concerns with basic research."*

Therefore, to account for any impacts in excess of those identified in Section 6.4, and to advance the information base concerning inundation impacts on vegetation, it is recommended that an adaptive management program be established. The flood control project is particularly suited for implementation of an adaptive management program for several reasons. First, as noted in Section 7.0, a degree of uncertainty is inherent in the project due to the lack of definitive studies. Second, because of the higher likelihood and frequency of flooding at lower elevations, floods in the reservoir would provide a laboratory to monitor flooding effects on vegetation and substrate during initial operational stages, and permit the measurement of the effectiveness, applicability, and utility of mitigation measures. Measures that appear to work best can than be adopted for the entire reservoir if and when they are required. Third, the proposed project provides the opportunity to integrate adaptive management strategies within the framework of the Operation and Maintenance (O&M) program, which would permit mitigation and monitoring to be performed concurrently with other maintenance and repair activities following floods, and would assure a consistent funding base.

The adaptive management program would require the approve and participation of a number of state and federal resource agencies for the purpose of identifying key variables and sites for continuous monitoring, testing the underlying ecological principals involved in the assessment, and for determining monitoring techniques, such as HEP. Additionally, agreements between the resource agencies and the project sponsors would be necessary to assure continued implementation, funding, and assurance of continuing mitigation if required. The following protocol is suggested as a framework for conducting such studies. Coordination with project sponsors and resource agencies will refine and more thoroughly define both the goals and process to provide a more comprehensive approach to preserving/maintaining the vegetation and habitat values of the American River Canyon. The basic format presented below is based on the framework suggested by Orians (1986):

1) **Define Environmental Goals and Scientific Questions.**

   a. identify the components of the environment perceived as valuable to the community, e.g., habitat value, recreational value, aesthetic value, etc;
   b. determine the desired degree of protection, acceptable loss limits, desired state (e.g, control of natural perturbations such as fire, or other dysclimax events), and length of time for protection;
   c. determine costs of managing the system from environmental, recreational, and financial perspectives.

2) **Scope the Problem.**

   a. define scientific objectives;
   b. determine which ecosystem components can be impacted by the project directly and indirectly;
   c. determine if ecosystem components could be studied either directly or indirectly;
   d. determine if surrogate species or indicator species would provide acceptable levels of detail;
   e. establish temporal, spatial, and ecological study boundaries:
      i) determination of duration of studies to collect sufficient information to make reasonable estimates;
      ii) determination of area to be sampled;
      iii) determination of biological and/or ecosystem processes requiring analysis;

3) **Develop and Test Hypotheses.**

   a. specify predictions and determine the significance of effects;
   b. predict ecological change that can be used in decision-making;
   c. assure that effect measured is tied closely to the environmental goals;

4) **Collect Baseline Information to determine existing/pre-inundation conditions.**

   a. establish in-canyon and control plots and/or transects representing key vegetative communities;
   b. sample sites need to represent various elevations and the longitudinal profile of the canyon;
   c. sampling should be performed periodically throughout the year to adjust for seasonal variation;
   d. determine composition, density (absolute and relative), frequency (absolute and relative), dominance (absolute coverage and relative coverage), importance value, age structure, and vigor of key vegetative indicator species within representative cover types;

e. conduct faunal surveys (small mammal live-trapping, breeding bird and wintering bird surveys, etc.) of representative taxa within sampling plots to establish species composition, density, and seasonal activity patterns;
f. use and refine HEP data to profile general habitat values of cover types in the canyon and at control sites;
g. delineate sites of historic slides;
h. inventory felled vegetation to compare against potential losses from windthrow.
i. perform geotechnical studies to determine baseline conditions concerning slope stability;

5) **Impact Monitoring.**

a. using baseline evaluation criteria list above, perform post-flood studies of in-canyon and control plots to document any statistically significant changes to:
   i) specific species and/or vegetative communities;
   ii) determine location, extent, and type of new slide areas; and,
   iii) document changes in wildlife habitat.
b. ascertain whether actual losses comport with pre-project loss estimates, and adjust impact assessments based on new, site-specific data;
c. monitor effectiveness of mitigation measures, such as vegetative plantings, biotechnical stabilization measures, etc.
d. based on post-flood observations and analyses, refine mitigation measures to eliminate those measures which are ineffective; supplement off-site land acquisitions; and incorporate new state-of-the-art measures for experimental purposes.
e. track the effects of activities that might be cumulative.

6) **Reporting the Results.**

a. in compliance with NEPA and CEQA regulations, report on the findings of the mitigation and impact monitoring studies;
b. distribute study findings for purpose of application to other studies;

9.0 CONCLUSIONS

1) Based on reviews of pertinent literature, site flooding history, and analysis and examination of analog sites, periodic inundation of the American River canyon resulting from operation of the proposed 200-yr flood control dam is estimated to result in the loss of approximately 600 acres of vegetation.in the American River canyon is likely to impact approximately 600 acres. Based on slope stability studies of the American River canyon, it is estimated that between 200 and 1,100 acres of vegetation could be lost as a result of slope failures induced by periodic flooding. In total, it is estimated that the loss of vegetation resulting from the operation of the flood control dam would range from 800 to 1,700 acres.

2) Because of the level of uncertainty associated with the estimates of physiological and physical loss of vegetation from periodic inundation, a two-phase mitigation program is recommended. First, approximately 1,600 acres of suitable lands should be acquired to mitigate for estimated losses. Second, a post-flood remediation program should be included in the Operation and Maintenance program to repair damaged sites and to provide additional mitigation plantings if losses exceed projected impacts. These measures should be fully described in a mitigation monitoring plan, which would also involve studies to determine pre-inundation vegetation compositions and densities in representative areas, and to develop long-term monitoring procedures and adaptive management strategies to accurately assess inundation impacts and to more effectively target remediation efforts.

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APPENDIX A

APPENDIX A

Attachment C1	USBR Water Surface Elevations Upstream of Cofferdam During January 1978 Inundation Event
Attachment C2	USBR Water Surface Elevations Upstream of Cofferdam During February/March 1978 Inundation Event
Attachment C3	USBR Water Surface Elevations Upstream of Cofferdam During February 1982 Inundation Event
Attachment C4	USBR Water Surface Elevations Upstream of Cofferdam During February 1986 Inundation Event
Attachment C5	Daily Discharge Records for Keswick Dam Gaging Station for Water Year October 1985 to September 1986
Attachment C6	Expanded Rating Table for Keswick Dam Gaging Station
Attachment C7	Primary Computations of Gage Height and Discharge for the American River at Fair Oaks During February 1986 Storms

SHEET 3

AUBURN DAM

WATER SURFACE ELEVATION (STAFF GAUGES)

UPSTREAM OF COFFER DAM

DATE	TIME	WATER SURFACE ELEVATION	REMARKS
1-10-78	3:00 PM	507.2	U/S PORTAL DIV. TUN.
"	3:00 PM	467.0	D/S " " "
"	5:00 PM	467.0	" " " "
"	7:00 PM	467.0	" " " "
"	8:15 PM	467.0	" " " "
1-11	9:00 AM	504.0	U/S " " "
"	1:00 PM	503.8	" " " "
"	2:00 PM	469.0	D/S " " "
"	4:45 PM	469.0	" " " "
"	7:00 PM	469.0	" " " "
"	9:00 PM	469.0	" " " "
"	10:45 PM	469.0	" " " "
1-12	8:00 AM	502.5	U/S " " "
"	8:00 AM	471.0	D/S " " "
"	7:00 PM	471.5	" " " "
"	9:30 PM	472.0	" " " "
1-13	9:30 AM	471.5	" " " "
"	10:00 AM	501.8	U/S " " "
"	5:00 PM	472.0	D/S " " "
"	8:00 PM	472.0	" " " "
1-15	11:30 AM	472.0	" " " "
1-16	8:00 AM	513.5	STAFF GAUGE U/S
"	12:00 PM	514.0	U/S PORTAL DIV. TUN.
"	2:00 PM	514.0	" " " "
"	8:00 AM	469.0	D/S " " "
"	2:00 PM	469.0	" " " "
"	5:00 PM	470.5	" " " "
"	8:00 PM	473.0	" " " "
			U/S PORTAL DIV. TUN. COVERED @ 8:00 P

ATTACHMENT A1

SHEET -1-

AUBURN DAM

WATER SURFACE ELEVATION (STAFF GAUGES)

UPSTREAM OF COFFER DAM

DATE	TIME	WATER SURFACE ELEVATION	REMARKS
1-17-78	8:00 AM	528^{0}	Peak U/S PORTAL DIV. TUN.
"	8:00 AM	475^{0}	D/S " " "
"	9:00 AM	527^{5}	U/S " " "
"	9:00 AM	475^{0}	D/S " " "
"	2:00 PM	525^{0}	U/S " " "
"	2:00 PM	474^{0}	D/S " " "
"	4:30 PM	473^{5}	" " " "
"	6:30 PM	473^{5}	" " " "
1-18-78	8:30 AM	470^{0}	" " " "
"	10:30 AM	515^{0}	U/S " " "
"	12:10 PM	514^{1}	STAFF GAUGE U/S
"	1:00 PM	513^{9}	" " "
"	4:30 PM	469^{0}	D/S PORTAL DIV. TUN.
"	6:30 PM	469^{0}	" " " "
1-19	7:40 AM	511^{3}	STAFF GAUGE U/S
"	9:00 AM	469^{0}	D/S PORTAL DIV. TUN.
"	12:00 PM	469^{0}	" " " "
"	12:00 PM	511^{0}	STAFF GAUGE U/S
"	3:00 PM	510^{0}	U/S PORTAL DIV. TUN.
"	5:00 PM	468^{5}	D/S " " "
"	8:00 PM	468^{5}	" " " "
1-20	9:00 AM	468	" " "
"	9:00 AM	508^{0}	U/S " " "
"	2:00 PM	507^{2}	" " " "
"	2:00 PM	508^{1}	STAFF GAUGE U/S
"	5:00 PM	468^{0}	D/S PORTAL DIV. TUN.
"	7:30 PM	468^{0}	" " " "
1-23	8:00 AM	501^{0}	STAFF GAUGE U/S
"	2:30 PM	503^{8}	" " "

SHEET 1

AUBURN DAM

WATER SURFACE ELEVATION (STAFF GAUGES)

UPSTREAM OF COFFER DAM

DATE	TIME	WATER SURFACE ELEVATION	REMARKS
2-28-78	10:00 AM	501^{6}	STAFF GAUGE U/S
"	3:00 PM	501^{5}	" " "
3-1-78	9:00 AM	501^{7}	" " "
"	2:00 PM	501^{6}	" " "
3-2	8:00 AM	503^{0}	" " "
"	12:00 PM	504^{8}	" " "
"	2:30 PM	505^{6}	" " "
"	8:30 PM	508^{8}	" " "
3-3	7:00 AM	512^{1}	" " "
"	12:30 PM	513^{3}	" " "
"	3:30 PM	513^{0}	" " "
"	6:30 PM	512^{7}	" " "
3-4	7:30 AM	510^{3}	STAFF GAUGE U/S
"	1:00 PM	512^{0}	" " "
"	2:45 PM	513^{2}	" " "
3-5	7:45 AM	523^{9}	" " "
"	10:15 AM	523^{1}	" " "
"	1:00 PM	522^{6}	" " "
3-6	7:30 AM	519^{0}	" " "
"	12:00 PM	517^{6}	" " "
"	3:00 PM	516^{7}	" " "
"	6:30 PM	515^{6}	" " "
3-7	7:30 AM	512^{0}	" " "
"	12:30 PM	511^{9}	" " "
"	3:00 PM	511^{5}	" " "
3-8	6:30 AM	509^{0}	" " "
"	12:30 PM	508^{6}	" " "
"	2:30 PM	507^{2}	" " "
"	6:00 PM	508^{7}	" "

ATTACHMENT A2

HYDROGRAPH COMPUTATIONS

Date 2-[illegible]-82
2-17-82

1	2	3	4	5	6	7	8	9
Date / Time	Water Elev	Reservoir Storage (a.f.) Chart II-15	Tunnel Discharge (c.f.s.) Chart II-11	Avg. Tunnel Discharge (c.f.s.)	Change In Reser. Stor. (a.f.)	Time Interv. (hrs)	Inflow To Storage (c.f.s.) (col. 6 ÷ col. 7) x 12.1	Comput' Inflow (c... col. 5 + c...
2-15-82	540.0	4997	27925					
1:00 PM								
3:00	523.5	[illegible]	30427	29176	611	1	7392.1	[illegible]
4:00 PM	[illegible]	7154	35735	[illegible]	[illegible]	2	[illegible]	[illegible]
6:00 PM	551.3	7745	37545	[illegible]	531	2	[illegible]	[illegible]
8:00 PM	[illegible]	[illegible]	43250	[illegible]	[illegible]	2	[illegible]	[illegible]
10:00 PM	[illegible]	12090	[illegible]	[illegible]	[illegible]	2	[illegible]	[illegible]
12:00 P	583.6	17268	49336	[illegible]	5178	2	[illegible]	[illegible]
2-16 2:00 A	605.9	23218	52851	[illegible]	5950	2	[illegible]	[illegible]
4:00	618.3	29068	56115	54 483.0	5850	2	35 392.5	[illegible]
6:00 A	628.9	[illegible]	58262	57,189.5	5523	2	34 444.[illegible]	[illegible]
8:00 A	634.3	38121	59430	[illegible]	3525	2	[illegible]	[illegible]
9:00 A	[illegible]	33377	59668	[illegible]	756	1	9147.6	[illegible]
10:00 A	[illegible]	39132	59747	59 707.5	255	1	2722.5	[illegible]
11:00 A	636.2	[illegible]	59708	59727.5	- 127	1	-1536.7	53190.
12:00 A	635.3	[illegible]	59529	59618.5	- 571	1	-6909.1	52702
1:00 P	634.0	37624	59272	59 400.5	- 810	1	- 9801.0	49599
2:00 P	631.9	[illegible]	58956	59 054.0	-1336	1	-16,165.6	[illegible]
3:00 P	629.8	35112	58440	58 638.0	-1175	1	-14 217.5	44 420
4:00 P	627.0	33529	57886	58163.0	-1584	1	-19166.4	38,996
6:00 P	620.6	30179	56619	57 252.5	-3350	2	- 20,267.5	36,985
8:00 P	612.8	26608	54868	55 743.5	- 3571	2	- 21,604.5	34,139
10:00 P	604.4	23200	52964	53916.0	- 3218	2	- 19,462.9	[illegible]
2-17-82 12:00 A	595.2	19615	50879	51921.5	- 3775	2	- 22,838.7	29,082
2:00 A	585.0	16061	48400	49639.5	- 3554	2	- 21,501.7	28,137
4:00 A	573.5	12540	45305	46852.5	- 3521	2	- 21,302.0	[illegible]
6:00 A	560.4	9127	40430	42867.5	- 3413	2	- 20,649.6	[illegible]
8:00 A	546.0	6068	32150	36290.0	- 3059	2	- 18 506.95	[illegible]

End River watch

ATTACHMENT A3

HYDROGRAPH COMPUTATIONS

Date 2/16/86

1	2	3	4	5	6	7	8	9
Date / Time 2/16/86	Water Elev	Reservoir Storage (a.f.) Chart H-16	Tunnel Discharge (c.f.s) Chart H-11	Avg. Tunnel Discharge (c.f.s.)	Change In Reser. Stor. (a.f.)	Time Interv. (hrs)	Inflow To Storage (c.f.s.) (col. 6 ÷ col. 7) x 12.1	Computed Inflow (c.f.s) col. 5 + col.
4:12	[illegible]	[illegible]	[illegible] 495					
5:00	[illegible]	[illegible]	[illegible]	27067	+334	.8	[illegible]	[illegible]
6:00	541.3	5 [illegible]	[illegible]	[illegible]	[illegible]	1.0	[illegible]	[illegible]
700	541.7	[illegible]	[illegible]	[illegible]	+ 37	[illegible]	[illegible]	[illegible]
800	541.6	[illegible]	29 059	[illegible]	− 17	[illegible]	− [illegible]	[illegible]
900	541.0	5 1[illegible]2	[illegible]	2[illegible],850	− 110	[illegible]	− 1[illegible]	[illegible] 519
1000	[illegible]	5 092	[illegible]	[illegible]	− [illegible]	[illegible]	− [illegible]	[illegible]
1100	540.3	[illegible]	[illegible]	[illegible] 210	− [illegible]	[illegible]	− 411	[illegible]
1200	539.1	[illegible]	[illegible]	[illegible]	− [illegible]	[illegible]	− [illegible]	[illegible]
1300	[illegible]	4 [illegible]	25,[illegible]	[illegible] 45	− [illegible]	[illegible]	− [illegible]	[illegible]
1400	[illegible]	[illegible]	[illegible]	[illegible] 135	− [illegible]	1.0	− [illegible]	[illegible]
1500	531.0	[illegible] 4	21 490	[illegible]	− [illegible]	1.0	− [illegible]	[illegible]
1600	[illegible]	3,437	[illegible]	[illegible]	− 167	[illegible]	− [illegible]	[illegible]

ATTACHMENT A4

HYDROGRAPH COMPUTATIONS

Date 2/16/86

100 [illegible]

1	2	3	4	5	6	7	8	9
Date / Time	Water Elev	Reservoir Storage (a.f.) Chart H-16	Tunnel Discharge (c.f.s.) Chart H-11	Avg. Tunnel Discharge (c.f.s.)	Change In Reser. Stor. (a.f.)	Time Interv. (hrs)	Inflow To Storage (c.f.s.) (col. 6 ÷ col. 7) x 12.1	Compute Inflow (c.f.s.) col. 5 + co[l. 8]
1600	527.4	3437	20,632					
1930 4.2	533.0	3892	22,920	21776	+455	3.5	1573	23,349
2030	537.8	4633	26,352	24636	+741	1.0	8966	33,602
2130	543.3	5572	30,284	28318	+939	1.0	11362	39,[illegible]
2230	547.8	6413	33,320	31802	+841	1.0	10,176	41,[illegible]
2330	552.2	7299	36,180	34750	+886	1.0	10,721	45,471
0030	557.6	8477	39,170	37675	+886	1.0	10,721	48,395
0130	561.2	9318	40,792	39,932	+841	1.0	10176	50,108
0230 3.7	567.3	10,847	43,258	42,025	+1529	1.0	18,501	60,526
0330 4.3	573.0	12,398	45,840	44200	+1551	1.0	18,767	62967
0430 6.9	579.3	14,253	46,918	46,029	+1855	1.0	22,446	68,475
0530 6.6	586.2	16,457	48,712	47,815	+2204	1.0	26,668	74,483
0630	593.0	18,813	50,380	49,546	+2356	1.0	28,508	78,054
0730 8.	603.0	22,916	52,647	51,514	+4103	1.0	49,646	101,160
0830	611.0	25,664	54,460	53,554	+2748	1.0	33,251	86,804
0930 7.7	619.5	29,642	56,387	55,424	+3978	1.0	48,134	103,557
1030 7.5	627.2	33,639	57,926	57,156	+3997	1.0	48,363	105,520
1130 7.2	634.7	38,059	59,411	58,668	+4420	1.0	53,482	112,150
1230 6.0	641.5	42,513	60,757	60,084	+4454	1.0	53,893	113,977
1330 5.8	647.5	46,798	61,945	61,351	+4285	1.0	51,848	113,199
1430 5.4	653.3	51,256	63,093	62,519	+4458	1.0	53,942	116,461
1530 4.8	658.7	55,684	64,163	63,628	+4428	1.0	53,579	117,207
1630 5.0	663.5	59,847	65,113	64,638	+4163.00	1.0	50,372	115,010
1730 5.0	668.5	64,408	66,103	65,608	+4561	1.0	55,188	120,796
18:30	673.5	69,201	67,000	66,552	+4793	1.0	57,995	124,547
19:30	677.7	73,404	67,800	67,400	+4203	1.0	50,856	118,256
20:30	682.0	77,876	68,500	69,150	+4472	1.0	54,111	12[illegible]
21:30	686.7	82,959	69,200	68,350	+5083	1.0	61,504	130,3[illegible]
2230	691.2	88,017	70,000	69,600	+5058	1.0	61,202	130,8[illegible]
23:30	695.7	93,261	70,800	70,400	+5244	1.0	63,452	133,8[illegible]
0030	700.1	98,569	71,600	71,200	+5,308	1.0	64,227	135,4[illegible]
01:30	704.3	103,802	72,300	71,950	+5,233	1.0	63,319	135,2[illegible]
0230	707.7	108,158	72,800	72,550	+4356	1.0	52,708	125,2[illegible]
0300	709.3	110,245	73,200	73,011	+2087	0.5	50,505	123,5[illegible]
0330	710.9	112,355	73,400	73,300	+2110	0.5	51,062	124,3[illegible]
0400	712.1	113,953	73,600	73,500	+1598	0.5	38,671	112,1[illegible]
0430	713.3	115,564	73,800	73,700	+1611	0.5	38,986	112,6[illegible]
0500	714.3	116,917	73,900	73,850	+1353	0.5	32,742	106,5[illegible]
0530	715.0	117,870	74,000	73,950	+953	0.5	23,062	97,0[illegible]
0730	716.5							
08.00	[illegible]	[illegible]						
0830	[illegible]	[illegible]						
0900	[illegible]	[illegible]						
[illegible]	[illegible]	[illegible]						

2-17-86

2-18-86

46.5

41.5

11370500 SACRAMENTO RIVER AT KESWICK, CA
(National stream-quality accounting network station)

LOCATION.--Lat 40°36'04", long 122°26'36", in SW 1/4 NW 1/4 sec.28, T.32 N., R.5 W., Shasta County, Hydrologic Unit 18020101, on right bank 0.4 mi upstream from Middle Creek, 0.8 mi downstream from Keswick Dam, 1.6 mi downstream from Keswick, and 10 mi downstream from Shasta Dam.
DRAINAGE AREA.--6,468 mi^2, excluding Goose Lake basin.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--October 1938 to current year. Monthly discharge only for some periods, published in WSP 1315-A.
REVISED RECORDS.--WSP 1931: Drainage area.
GAGE.--Water-stage recorder. Datum of gage is 479.81 ft above National Geodetic Vertical Datum of 1929. Prior to Oct. 1, 1939, at site 1.5 mi upstream at datum 20.2 ft higher and Oct. 1, 1939, to Apr. 30, 1942, at site 1.5 mi upstream at datum 15.2 ft higher. Aug. 20, 1960, to July 3, 1973, auxiliary water-stage recorder at city of Redding pumping plant 2.1 mi downstream.
REMARKS.--Estimated daily discharges: Oct. 23 to Nov. 4 and Apr. 16-20. Records good. Flow completely regulated by Shasta Dam (station 11370000) beginning Dec. 30, 1943, and Keswick Reservoir, capacity, 4,170 acre-ft. No diversion for irrigation between Shasta Dam and station at Keswick. Since December 1963, water is released from Whiskeytown Lake (station 11371700), through a tunnel to Spring Creek powerplant (station 11371600), and then into Keswick Reservoir. See schematic diagram of Pit and McCloud River basins.
AVERAGE DISCHARGE.--25 years (water years 1939-63), 8,376 ft^3/s, 6,064,000 acre-ft/yr, adjusted for change in contents and evaporation from Shasta Lake prior to transbasin diversion to Keswick Reservoir; 23 years (water years 1964-86), 9,142 ft^3/s, 6,623,000 acre-ft/yr, including adjustment for transbasin diversion; unadjusted flow for period of record, 9,441 ft^3/s, 6,840,000 acre-ft/yr.
EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 185,000 ft^3/s, Feb. 23, 1940, gage height, 47.2 ft site and datum then in use, from rating curve extended above 75,000 ft^3/s on basis of peak discharge at Kennet plus 4,000 ft^3/s estimated inflow; minimum observed, 2,730 ft^3/s, Aug. 22, 1939. Maximum discharge since completion of Shasta Dam in 1944, 81,400 ft^3/s, Apr. 1, 1974, gage height, 31.92 ft; maximum gage height, 32.22 ft, Jan. 24, 1970; minimum, 154 ft^3/s, May 15, 1948.
EXTREMES FOR CURRENT YEAR.--Maximum discharge, 76,900 ft^3/s, Feb. 19, gage height, 31.93 ft; minimum daily, 3,420 ft^3/s, Feb. 8.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1985 TO SEPTEMBER 1986
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	5120	4510	4250	4200	4020	62100	4330	8130	8120	11500	10900	9900
2	5160	4550	4620	4190	4720	52000	4070	8150	8210	11100	11000	9930
3	5110	4600	4500	4190	5530	38400	4050	8140	8240	11100	11000	9430
4	5170	4580	4320	4180	5120	26200	4050	8130	8240	11100	10900	7850
5	4790	4600	4220	4200	4930	19100	4040	7870	8260	11200	10400	6450
6	4670	4860	4100	4200	4940	16800	4090	7830	7900	11100	10400	6170
7	4560	4870	4180	4200	3940	30200	4040	8100	8470	11100	10400	5750
8	4540	4730	4170	4190	3420	34400	4030	8190	8500	11000	10400	5130
9	4350	4570	4140	4190	3520	38300	4030	8110	9100	10900	10400	5120
10	4630	4580	4200	4200	3550	43800	4040	8050	9230	10900	10400	5190
11	4430	4550	4200	4240	3590	52300	4080	8040	10200	10900	10400	5220
12	4540	4480	4210	4210	3770	52100	4150	8980	10400	11000	10400	5580
13	4450	4370	4180	4190	4260	51600	4130	14600	10400	10900	10500	6220
14	4630	4440	4160	4230	9440	48300	4150	14700	10900	11000	10500	7770
15	4610	4530	4150	4320	28500	38400	4220	11700	11000	10900	10600	7820
16	4580	4420	4200	5480	38900	38000	4240	9050	11000	11000	10600	7800
17	4620	4400	4180	4880	31100	35300	4260	8630	10900	10900	10600	7790
18	4590	4390	4240	4320	53300	28600	4280	8620	11000	11600	10400	7500
19	4620	4660	4260	4150	69700	22600	4290	8600	11000	12100	10400	7520
20	4560	4690	4220	4350	73700	19100	4300	8090	11000	12000	10500	7530
21	4570	4660	4190	4270	73500	18300	5250	7590	11000	11900	10500	7530
22	4560	4650	4180	4130	73200	16100	5180	7580	11200	11900	10500	7530
23	4320	4670	4190	4150	72900	13900	5040	7620	11100	12000	9970	7640
24	4320	4740	4170	4080	72800	13900	6780	7680	11100	12000	9940	8610
25	4210	4650	4170	3930	72600	11900	6930	7590	11000	12000	9970	8290
26	4340	4190	4180	3970	71700	9780	6940	7610	11000	12100	9940	8360
27	4350	4240	4180	4040	64700	7650	7020	7650	11100	12100	9980	8350
28	4500	4650	4180	4170	63000	6040	6920	7770	11500	12000	9950	8390
29	4310	4710	4180	4380	---	5280	6960	7670	11600	11600	10000	8400
30	4080	4260	4190	4910	---	5260	7530	7750	11500	11000	9930	8270
31	4320	---	4180	4420	---	4960	---	7700	---	11000	9930	---
TOTAL	141610	136800	130690	132760	924350	860670	147420	265920	304170	352900	321710	223040
MEAN	4568	4560	4216	4283	33010	27760	4914	8578	10140	11380	10380	7435
MAX	5170	4870	4620	5480	73700	62100	7530	14700	11600	12100	11000	9930
MIN	4080	4190	4100	3930	3420	4960	4030	7580	7900	10900	9930	5120
AC-FT	280900	271300	259200	263300	1833000	1707000	292400	527500	603300	700000	638100	442400
MEAN a	4298	4557	6578	12850	45450	23960	10050	7932	5015	4653	4235	4570
AC-FT a	264300	271100	404400	790200	2524000	1474000	597900	487700	298400	286100	260400	271900

CAL YR 1985 TOTAL 2675900 MEAN 7331 MAX 15500 MIN 3860 AC-FT 5308000 MEAN a 5340 AC-FT a 3866000
WTR YR 1986 TOTAL 3942040 MEAN 10800 MAX 73700 MIN 3420 AC-FT 7819000 MEAN a 10950 AC-FT a 7930000

a Adjusted for change in contents and unreviewed evaporation from Shasta Lake and transbasin diversion into Keswick Reservoir.

ATTACHMENT A5

RT 20

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION

EXPANDED RATING TABLE

DATE PROCESSED: 03-30-1989 @ 06:59 BY MFFRIEBEL

PAGE

TYPE: LOG

11370500

SACRAMENTO RIVER AT KESWICK, CALIF.

OFFSET: 5.00 Openwater Rating

DD: 3 TYPE: 001 RATING NO: 002

START DATE/TIME: 11-23-88 (0130

BASED ON 5 DISCHARGE MEASUREMENTS, NOS 928-932, AND ________, AND IS ______ WELL DEFINED BETWEEN ______ AND ______ CFS

and is the same as RT19 above 20ft.

COMP BY MFF DATE 3-29-89 CHK. BY WES DATE 3-29-89

DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION)

GAGE HEIGHT (FEET)	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH FT
6.10	2260*	2269	2278	2287	2295	2304	2313	2321	2330	2339	87.00
6.20	2347	2356	2364	2373	2381	2389	2398	2406	2414	2422	83.00
6.30	2430	2438	2447	2455	2463	2471	2479	2486	2494	2502	80.00
6.40	2510*	2519	2528	2537	2546	2555	2564	2573	2581	2590	89.00
6.50	2599	2608	2617	2625	2634	2643	2651	2660	2668	2677	86.00
6.60	2685	2694	2702	2711	2719	2727	2736	2744	2752	2761	84.00
6.70	2769	2777	2785	2793	2802	2810	2818	2826	2834	2842	81.00
6.80	2850*	2859	2867	2876	2884	2893	2901	2910	2918	2927	85.00
6.90	2935	2944	2952	2961	2969	2977	2986	2994	3002	3010	84.00
7.00	3019	3027	3035	3043	3052	3060	3068	3076	3084	3092	81.00
7.10	3100	3108	3116	3124	3132	3140	3148	3156	3164	3172	80.00
7.20	3180*	3189	3198	3206	3215	3224	3232	3241	3250	3258	87.00
7.30	3267	3276	3284	3293	3302	3310	3319	3327	3336	3344	86.00
7.40	3353	3361	3370	3378	3387	3395	3403	3412	3420	3429	84.00
7.50	3437	3445	3454	3462	3470	3479	3487	3495	3504	3512	83.00
7.60	3520*	3529	3539	3548	3558	3567	3577	3586	3595	3605	94.00
7.70	3614	3623	3633	3642	3651	3661	3670	3679	3688	3698	93.00
7.80	3707	3716	3725	3735	3744	3753	3762	3771	3781	3790	92.00
7.90	3799	3808	3817	3826	3835	3845	3854	3863	3872	3881	91.00
8.00	3890*	3900	3909	3919	3928	3938	3947	3957	3966	3976	96.00
8.10	3986	3995	4005	4014	4024	4033	4042	4052	4061	4071	94.00
8.20	4080	4090	4099	4109	4118	4127	4137	4146	4155	4165	94.00
8.30	4174	4184	4193	4202	4212	4221	4230	4240	4249	4258	93.00
8.40	4267	4277	4286	4295	4305	4314	4323	4332	4342	4351	93.00
8.50	4360*	4370	4380	4390	4400	4411	4421	4431	4441	4451	101.0
8.60	4461	4471	4481	4491	4501	4511	4521	4531	4541	4551	100.0
8.70	4561	4572	4582	4592	4602	4612	4622	4632	4642	4651	100.0
8.80	4661	4671	4681	4691	4701	4711	4721	4731	4741	4751	100.0
8.90	4761	4771	4781	4791	4801	4811	4820	4830	4840	4850	99.00
9.00	4860*	4870	4879	4889	4899	4909	4918	4928	4938	4947	97.00
9.10	4957	4967	4976	4986	4996	5005	5015	5024	5034	5044	96.00
9.20	5053	5063	5073	5082	5092	5101	5111	5121	5130	5140	96.00
9.30	5149	5159	5168	5178	5188	5197	5207	5216	5226	5235	96.00
9.40	5245	5254	5264	5273	5283	5292	5302	5311	5321	5330	95.00
9.50	5340*	5350	5361	5371	5381	5391	5402	5412	5422	5432	103.0
9.60	5443	5453	5463	5473	5484	5494	5504	5514	5524	5535	102.0
9.70	5545	5555	5565	5575	5586	5596	5606	5616	5626	5637	102.0
9.80	5647	5657	5667	5677	5688	5698	5708	5718	5728	5738	102.0

ATTACHMENT A6

UNITED STATES DEPARTMENT OF INTERIOR GEOLOGICAL SURVEY WATER RESOURCES DIVISION

EXPANDED RATING TABLE TYPE: LOG

DATE PROCESSED: 03-30-1989 @ 06:57 BY MFFRIEBEL

11370500

SACRAMENTO RIVER AT KESWICK, CALIF.

OFFSET: 5.00

DD: 3 TYPE: 001 RATING NO: 0020

START DATE/TIME: 11-23-88 (0130)

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND .00	.01	.02	.03	.04	.05	(EXPANDED PRECISION) .06	.07	.08	.09	DIFF IN Q PER TENTH FT
9.90	5749	5759	5769	5779	5789	5799	5809	5820	5830	5840	101.0
10.00	5850*	5862	5874	5886	5898	5910	5922	5934	5946	5958	120.0
10.10	5970	5982	5994	6006	6018	6030	6042	6054	6066	6078	120.0
10.20	6090	6102	6114	6126	6138	6150	6162	6174	6186	6198	120.0
10.30	6210	6222	6234	6246	6258	6270	6282	6294	6306	6318	120.0
10.40	6330	6342	6354	6366	6378	6390	6402	6414	6426	6438	120.0
10.50	6450*	6463	6475	6488	6500	6513	6525	6538	6551	6563	126.0
10.60	6576	6588	6601	6613	6626	6639	6651	6664	6676	6689	126.0
10.70	6702	6714	6727	6739	6752	6764	6777	6790	6802	6815	126.0
10.80	6828	6840	6853	6865	6878	6891	6903	6916	6928	6941	126.0
10.90	6954	6966	6979	6992	7004	7017	7029	7042	7055	7067	126.0
11.00	7080*	7093	7107	7120	7133	7147	7160	7173	7187	7200	133.0
11.10	7213	7227	7240	7254	7267	7280	7294	7307	7320	7334	134.0
11.20	7347	7361	7374	7387	7401	7414	7428	7441	7454	7468	134.0
11.30	7481	7495	7508	7521	7535	7548	7562	7575	7589	7602	134.0
11.40	7615	7629	7642	7656	7669	7683	7696	7710	7723	7737	135.0
11.50	7750*	7764	7778	7792	7806	7820	7834	7847	7861	7875	139.0
11.60	7889	7903	7917	7931	7945	7959	7973	7987	8001	8015	140.0
11.70	8029	8043	8057	8071	8085	8099	8113	8127	8141	8155	140.0
11.80	8169	8183	8197	8211	8225	8239	8253	8267	8281	8295	140.0
11.90	8309	8323	8337	8351	8366	8380	8394	8408	8422	8436	141.0
12.00	8450*	8464	8478	8492	8505	8519	8533	8547	8561	8575	139.0
12.10	8589	8603	8616	8630	8644	8658	8672	8686	8700	8714	139.0
12.20	8728	8742	8756	8769	8783	8797	8811	8825	8839	8853	139.0
12.30	8867	8881	8895	8909	8923	8937	8951	8965	8979	8993	140.0
12.40	9007	9021	9035	9049	9063	9077	9091	9105	9119	9133	140.0
12.50	9147	9161	9175	9189	9203	9217	9231	9245	9259	9273	140.0
12.60	9287	9301	9315	9329	9343	9357	9371	9385	9399	9413	140.0
12.70	9427	9441	9455	9469	9483	9497	9511	9526	9540	9554	141.0
12.80	9568	9582	9596	9610	9624	9638	9652	9666	9681	9695	141.0
12.90	9709	9723	9737	9751	9765	9779	9793	9808	9822	9836	141.0
13.00	9850*	9864	9878	9892	9906	9920	9934	9948	9962	9976	140.0
13.10	9990	10000	10020	10030	10050	10060	10070	10090	10100	10120	140.0
13.20	10130	10140	10160	10170	10190	10200	10210	10230	10240	10260	140.0
13.30	10270	10280	10300	10310	10330	10340	10350	10370	10380	10400	140.0
13.40	10410	10420	10440	10450	10470	10480	10490	10510	10520	10540	140.0
13.50	10550*	10570	10580	10600	10610	10630	10650	10660	10680	10690	160.0

EXPANDED RATING TABLE
DATE PROCESSED: 03-30-1989 @ 06:59 BY MFFRIEBEL

TYPE: LOG

.1370500
SACRAMENTO RIVER AT KESWICK, CALIF.
OFFSET: 5.00

DD: 3 TYPE: 001 RATING NO: 00
START DATE/TIME: 11-2[illegible]-83 (013

DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION)

GAGE HEIGHT (FEET)	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN PER TENTH F
13.60	10710	10720	10740	10760	10770	10790	10800	10820	10840	10850	160.0
13.70	10870	10880	10900	10920	10930	10950	10960	10980	11000	11010	160.0
13.80	11030	11040	11060	11080	11090	11110	11120	11140	11160	11170	160.0
13.90	11190	11210	11220	11240	11250	11270	11290	11300	11320	11330	160.0
14.00	11350*	11370	11380	11400	11410	11430	11440	11460	11480	11490	160.0
14.10	11510	11520	11540	11560	11570	11590	11600	11620	11630	11650	160.0
14.20	11670	11680	11700	11710	11730	11750	11760	11780	11790	11810	160.0
14.30	11830	11840	11860	11870	11890	11910	11920	11940	11950	11970	150.0
14.40	11980	12000	12020	12030	12050	12060	12080	12100	12110	12130	160.0
14.50	12140	12160	12180	12190	12210	12220	12240	12260	12270	12290	160.0
14.60	12300	12320	12340	12350	12370	12390	12400	12420	12430	12450	170.0
14.70	12470	12480	12500	12510	12530	12550	12560	12580	12590	12610	160.0
14.80	12630	12640	12660	12670	12690	12710	12720	12740	12760	12770	160.0
14.90	12790	12800	12820	12840	12850	12870	12890	12900	12920	12930	160.0
15.00	12950*	12970	12980	13000	13010	13030	13040	13060	13080	13090	160.0
15.10	13110	13120	13140	13160	13170	13190	13200	13220	13240	13250	160.0
15.20	13270	13280	13300	13310	13330	13350	13360	13380	13390	13410	160.0
15.30	13430	13440	13460	13470	13490	13510	13520	13540	13550	13570	160.0
15.40	13590	13600	13620	13630	13650	13670	13680	13700	13710	13730	160.0
15.50	13750	13760	13780	13790	13810	13830	13840	13860	13870	13890	160.0
15.60	13910	13920	13940	13950	13970	13990	14000	14020	14030	14050	160.0
15.70	14070	14080	14100	14110	14130	14150	14160	14180	14200	14210	160.0
15.80	14230	14240	14260	14280	14290	14310	14320	14340	14360	14370	160.0
15.90	14390	14400	14420	14440	14450	14470	14490	14500	14520	14530	160.0
16.00	14550*	14570	14580	14600	14620	14630	14650	14670	14680	14700	170.0
16.10	14720	14730	14750	14770	14790	14800	14820	14840	14850	14870	170.0
16.20	14890	14900	14920	14940	14950	14970	14990	15000	15020	15040	170.0
16.30	15060	15070	15090	15110	15120	15140	15160	15170	15190	15210	170.0
16.40	15230	15240	15260	15280	15290	15310	15330	15340	15360	15380	160.0
16.50	15390	15410	15430	15450	15460	15480	15500	15510	15530	15550	180.0
16.60	15570	15580	15600	15620	15630	15650	15670	15680	15700	15720	170.0
16.70	15740	15750	15770	15790	15800	15820	15840	15860	15870	15890	170.0
16.80	15910	15920	15940	15960	15980	15990	16010	16030	16040	16060	170.0
16.90	16080	16100	16110	16130	16150	16160	16180	16200	16220	16230	170.0
17.00	16250*	16270	16290	16310	16330	16350	16370	16390	16410	16430	200.0
17.10	16450	16460	16480	16500	16520	16540	16560	16580	16600	16620	190.0
17.20	16640	16660	16680	16700	16720	16740	16760	16780	16800	16820	200.0
17.30	16840	16860	16880	16900	16920	16940	16960	16980	17000	17010	190.0

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION

EXPANDED RATING TABLE

DATE PROCESSED: 03-30-1989 @ 06:59 BY MFFRIEBEL

TYPE: LOG

.1370500

SACRAMENTO RIVER AT KESWICK, CALIF.

DD: 3 TYPE: 001 RATING NO: 002

OFFSET: 5.00

START DATE/TIME: 11-23-88 (0130

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND .00	.01	.02	.03	.04	.05	(EXPANDED PRECISION) .06	.07	.08	.09	DIFF IN PER TENTH FT
17.40	17030	17050	17070	17090	17110	17130	17150	17170	17190	17210	200.0
17.50	17230	17250	17270	17290	17310	17330	17350	17370	17390	17410	200.0
17.60	17430	17450	17470	17490	17510	17530	17550	17570	17590	17610	200.0
17.70	17630	17650	17670	17690	17710	17730	17750	17770	17790	17810	200.0
17.80	17830	17850	17870	17890	17910	17930	17950	17970	17990	18010	200.0
17.90	18030	18050	18070	18090	18110	18130	18150	18170	18190	18210	200.0
18.00	18230	18250	18270	18290	18310	18330	18350	18370	18390	18410	200.0
18.10	18430	18460	18480	18500	18520	18540	18560	18580	18600	18620	210.0
18.20	18640	18660	18680	18700	18720	18740	18760	18780	18800	18820	200.0
18.30	18840	18860	18880	18900	18920	18940	18960	18980	19000	19020	210.0
18.40	19050	19070	19090	19110	19130	19150	19170	19190	19210	19230	200.0
18.50	19250*	19270	19300	19320	19350	19370	19390	19420	19440	19470	240.0
18.60	19490	19520	19540	19560	19590	19610	19640	19660	19690	19710	240.0
18.70	19730	19760	19780	19810	19830	19860	19880	19900	19930	19950	250.0
18.80	19980	20000	20030	20050	20080	20100	20130	20150	20170	20200	240.0
18.90	20220	20250	20270	20300	20320	20350	20370	20400	20420	20440	250.0
19.00	20470	20490	20520	20540	20570	20590	20620	20640	20670	20690	250.0
19.10	20720	20740	20770	20790	20820	20840	20870	20890	20920	20940	250.0
19.20	20970	20990	21020	21040	21070	21090	21120	21140	21170	21190	250.0
19.30	21220	21240	21270	21290	21320	21340	21370	21390	21420	21440	250.0
19.40	21470	21490	21520	21540	21570	21590	21620	21640	21670	21690	250.0
19.50	21720	21750	21770	21800	21820	21850	21870	21900	21920	21950	250.0
19.60	21970	22000	22020	22050	22080	22100	22130	22150	22180	22200	260.0
19.70	22230	22250	22280	22300	22330	22360	22380	22410	22430	22460	250.0
19.80	22480	22510	22540	22560	22590	22610	22640	22660	22690	22720	260.0
19.90	22740	22770	22790	22820	22840	22870	22900	22920	22950	22970	260.0
20.00	23000*	23020	23050	23070	23100	23120	23150	23170	23200	23220	250.0
20.10	23250	23270	23290	23320	23340	23370	23390	23420	23440	23470	240.0
20.20	23490	23520	23540	23570	23590	23620	23640	23670	23690	23710	250.0
20.30	23740	23760	23790	23810	23840	23860	23890	23910	23940	23960	250.0
20.40	23990	24010	24040	24060	24090	24110	24140	24160	24190	24210	250.0
20.50	24240	24260	24290	24310	24340	24360	24390	24410	24440	24460	250.0
20.60	24490	24510	24540	24560	24590	24610	24640	24660	24690	24710	250.0
20.70	24740	24760	24790	24820	24840	24870	24890	24920	24940	24970	250.0
20.80	24990	25020	25040	25070	25090	25120	25140	25170	25190	25220	260.0
20.90	25250	25270	25300	25320	25350	25370	25400	25420	25450	25470	250.0
21.00	25500*	25530	25560	25590	25620	25650	25680	25710	25740	25770	300.0

11370500
SACRAMENTO RIVER AT KESWICK, CALIF.
OFFSET: 5.00

EXPANDED RATING TABLE
DATE PROCESSED: 03-30-1989 @ 06:59 BY MFFRIEBEL

TYPE: LOG

DD: 3 TYPE: 001 RATING NO: 0020
START DATE/TIME: 11-23-88 (0130)

DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION)

GAGE HEIGHT (FEET)	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH FT
21.10	25800	25830	25860	25890	25920	25950	25980	26010	26040	26070	300.0
21.20	26100	26130	26160	26190	26220	26250	26280	26310	26340	26370	300.0
21.30	26400	26430	26460	26490	26530	26560	26590	26620	26650	26680	310.0
21.40	26710	26740	26770	26800	26830	26860	26890	26920	26950	26980	300.0
21.50	27010	27040	27080	27110	27140	27170	27200	27230	27260	27290	310.0
21.60	27320	27350	27380	27410	27450	27480	27510	27540	27570	27600	310.0
21.70	27630	27660	27690	27720	27760	27790	27820	27850	27880	27910	310.0
21.80	27940	27970	28000	28040	28070	28100	28130	28160	28190	28220	310.0
21.90	28250	28290	28320	28350	28380	28410	28440	28470	28510	28540	320.0
22.00	28570	28600	28630	28660	28700	28730	28760	28790	28820	28850	310.0
22.10	28880	28920	28750	28980	29010	29040	29070	29110	29140	29170	320.0
22.20	29200	29230	29270	29300	29330	29360	29390	29430	29460	29490	320.0
22.30	29520	29550	29590	29620	29650	29680	29710	29750	29780	29810	320.0
22.40	29840	29870	29910	29940	29970	30000	30040	30070	30100	30130	320.0
22.50	30160	30200	30230	30260	30290	30330	30360	30390	30420	30460	330.0
22.60	30490	30520	30550	30590	30620	30650	30680	30720	30750	30780	320.0
22.70	30810	30850	30880	30910	30940	30980	31010	31040	31080	31110	330.0
22.80	31140	31170	31210	31240	31270	31300	31340	31370	31400	31440	330.0
22.90	31470	31500	31540	31570	31600	31630	31670	31700	31730	31770	330.0
23.00	31800*	31840	31870	31910	31950	31980	32020	32060	32090	32130	360.0
23.10	32160	32200	32240	32270	32310	32350	32380	32420	32460	32500	370.0
23.20	32530	32570	32610	32640	32680	32720	32750	32790	32830	32860	370.0
23.30	32900	32940	32980	33010	33050	33090	33120	33160	33200	33240	370.0
23.40	33270	33310	33350	33380	33420	33460	33500	33530	33570	33610	380.0
23.50	33650	33680	33720	33760	33800	33830	33870	33910	33950	33980	370.0
23.60	34020	34060	34100	34140	34170	34210	34250	34290	34320	34360	380.0
23.70	34400	34440	34480	34510	34550	34590	34630	34670	34700	34740	380.0
23.80	34780	34820	34860	34890	34930	34970	35010	35050	35090	35120	380.0
23.90	35160	35200	35240	35280	35320	35350	35390	35430	35470	35510	390.0
24.00	35550	35580	35620	35660	35700	35740	35780	35820	35860	35890	380.0
24.10	35930	35970	36010	36050	36090	36130	36170	36200	36240	36280	390.0
24.20	36320	36360	36400	36440	36480	36520	36560	36590	36630	36670	390.0
24.30	36710	36750	36790	36830	36870	36910	36950	36990	37030	37070	390.0
24.40	37100	37140	37180	37220	37260	37300	37340	37380	37420	37460	400.0
24.50	37500*	37540	37580	37620	37670	37710	37750	37790	37830	37870	420.0
24.60	37920	37960	38000	38040	38080	38120	38170	38210	38250	38290	410.0
24.70	38330	38380	38420	38460	38500	38540	38590	38630	38670	38710	430.0
24.80	38760	38800	38840	38880	38920	38970	39010	39050	39090	39140	420.0

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION

EXPANDED RATING TABLE

DATE PROCESSED: 03-30-1989 @ 06:59 BY MFFRIEBEL

11370500

SACRAMENTO RIVER AT KESWICK, CALIF

OFFSET: 5.00

DD: 3 TYPE: 001 RATING NO: 003

START DATE/TIME: 11-23-88 (0130

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND .00	.01	.02	.03	.04	.05	(EXPANDED PRECISION) .06	.07	.08	.07	DIFF IN (PER TENTH FT
24.90	39180	39220	39260	39310	39350	39390	39430	39480	39520	39560	420.0
25.00	39600	39650	39690	39730	39780	39820	39860	39900	39950	39990	430.0
25.10	40030	40080	40120	40160	40210	40250	40290	40330	40380	40420	430.0
25.20	40460	40510	40550	40590	40640	40680	40720	40770	40810	40850	440.0
25.30	40900	40940	40980	41030	41070	41110	41160	41200	41250	41290	430.0
25.40	41330	41380	41420	41460	41510	41550	41600	41640	41680	41730	440.0
25.50	41770	41820	41860	41900	41950	41990	42040	42080	42120	42170	440.0
25.60	42210	42260	42300	42340	42390	42430	42480	42520	42570	42610	450.0
25.70	42660	42700	42740	42790	42830	42880	42920	42970	43010	43060	440.0
25.80	43100	43150	43190	43240	43280	43320	43370	43410	43460	43500	450.0
25.90	43550	43590	43640	43680	43730	43770	43820	43860	43910	43950	450.0
26.00	44000*	44040	44090	44140	44180	44230	44270	44320	44360	44410	450.0
26.10	44450	44500	44540	44590	44630	44680	44720	44770	44810	44860	460.0
26.20	44910	44950	45000	45040	45090	45130	45180	45220	45270	45320	450.0
26.30	45360	45410	45450	45500	45540	45590	45640	45680	45730	45770	460.0
26.40	45820	45870	45910	45960	46000	46050	46100	46140	46190	46240	460.0
26.50	46280	46330	46370	46420	46470	46510	46560	46610	46650	46700	470.0
26.60	46750	46790	46840	46890	46930	46980	47030	47070	47120	47170	460.0
26.70	47210	47260	47310	47350	47400	47450	47490	47540	47590	47630	470.0
26.80	47680	47730	47770	47820	47870	47920	47960	48010	48060	48100	470.0
26.90	48150	48200	48250	48290	48340	48390	18440	48480	48530	48580	480.0
27.00	48630	48670	48720	48770	48820	48860	48910	48960	49010	49050	470.0
27.10	49100	49150	49200	49250	49290	49340	49390	49440	49480	49530	480.0
27.20	49580	49630	49680	49720	49770	49820	49870	49920	49970	50010	480.0
27.30	50060	50110	50160	50210	50260	50300	50350	50400	50450	50500	490.0
27.40	50550	50590	50640	50690	50740	50790	50840	50890	50930	50980	480.0
27.50	51030	51080	51130	51180	51230	51280	51320	51370	51420	51470	490.0
27.60	51520	51570	51620	51670	51720	51770	51810	51860	51910	51960	490.0
27.70	52010	52060	52110	52160	52210	52260	52310	52360	52410	52460	500.0
27.80	52510	52550	52600	52650	52700	52750	52800	52850	52900	52950	490.0
27.90	53000	53050	53100	53150	53200	53250	53300	53350	53400	53450	500.0
28.00	53500*	53550	53610	53660	53720	53770	53830	53880	53940	53990	540.0
28.10	54040	54100	54150	54210	54260	54320	54370	54430	54480	54540	550.0
28.20	54590	54650	54700	54760	54810	54870	54920	54980	55030	55090	550.0
28.30	55140	55200	55250	55310	55360	55420	55470	55530	55590	55640	560.0
28.40	55700	55750	55810	55860	55920	55970	56030	56090	56140	56200	550.0
28.50	56250	56310	56370	56420	56480	56530	56590	56650	56700	56760	560.0

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION

EXPANDED RATING TABLE

TYPE: LOG

DATE PROCESSED: 03-30-1989 @ 06:59 BY MFFRIEBEL

11370500
SACRAMENTO RIVER AT KESWICK, CALIF.
OFFSET: 5.00

DD: 3 TYPE: 001 RATING NO: 0020
START DATE/TIME: 11-23-88 (0130)

DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION)

GAGE HEIGHT (FEET)	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH FT
32.40	79970	80040	80100	80170	80240	80300	80370	80440	80500	80570	670.0
32.50	80640	80700	80770	80830	80900	80970	81030	81100	81170	81230	660.0
32.60	81300	81370	81440	81500	81570	81640	81700	81770	81840	81900	670.0
32.70	81970	82040	82110	82170	82240	82310	82380	82440	82510	82580	670.0
32.80	82640	82710	82780	82850	82910	82980	83050	83120	83190	83250	680.0
32.90	83320	83390	83460	83520	83590	83660	83730	83800	83860	83930	680.0*
33.00	84000*										

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION PAGE
EXPANDED RATING TABLE TYPE: LOG
DATE PROCESSED: 03-30-1989 @ 06:59 BY MFFRIEBEL

11370500
SACRAMENTO RIVER AT KESWICK, CALIF. DD: 3 TYPE: 001 RATING NO: 002
OFFSET: 5.00 START DATE/TIME: 11-23-88 (0130

DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION)

GAGE HEIGHT (FEET)	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN PER TENTH FT
28.60	56810	56870	56930	56980	57040	57100	57150	57210	57260	57320	570.0
28.70	57380	57430	57490	57550	57600	57660	57720	57770	57830	57890	560.0
28.80	57940	58000	58060	58110	58170	58230	58290	58340	58400	58460	570.0
28.90	58510	58570	58630	58690	58740	58800	58860	58910	58970	59030	580.0
29.00	59090	59140	59200	59260	59320	59370	59430	59490	59550	59610	570.0
29.10	59660	59720	59780	59840	59890	59950	60010	60070	60130	60180	580.0
29.20	60240	60300	60360	60420	60480	60530	60590	60650	60710	60770	590.0
29.30	60830	60880	60940	61000	61060	61120	61180	61230	61290	61350	580.0
29.40	61410	61470	61530	61590	61650	61700	61760	61820	61880	61940	590.0
29.50	62000*	62060	62120	62170	62230	62290	62350	62400	62460	62520	580.0
29.60	62580	62640	62690	62750	62810	62870	62930	62990	63040	63100	580.0
29.70	63160	63220	63280	63340	63390	63150	63510	63570	63630	63690	590.0
29.80	63750	63800	63860	63920	63980	64040	64100	64160	64220	64270	580.0
29.90	64330	64390	64450	64510	64570	64630	64690	64750	64810	64860	590.0
30.00	64920	64780	65040	65100	65160	65220	65280	65340	65400	65460	600.0
30.10	65520	65580	65640	65700	65760	65820	65880	65940	65990	66050	590.0
30.20	66110	66170	66230	66290	66350	66410	66470	66530	66590	66650	600.0
30.30	66710	66770	66830	66900	66960	67020	67080	67140	67200	67260	610.0
30.40	67320	67380	67440	67500	67560	67620	67680	67740	67800	67860	600.0
30.50	67920	67980	68050	68110	68170	68230	68290	68350	68410	68470	610.0
30.60	68530	68590	68650	68720	68780	68840	68900	68960	69020	69080	610.0
30.70	69140	69210	69270	69330	69390	69450	69510	69580	69640	69700	620.0
30.80	69760	69820	69880	69950	70010	70070	70130	70190	70250	70320	620.0
30.90	70380	70440	70500	70560	70630	70690	70750	70810	70880	70940	620.0
31.00	71000*	71060	71120	71190	71250	71310	71370	71430	71500	71560	620.0
31.10	71620	71680	71750	71810	71870	71930	71990	72060	72120	72180	620.0
31.20	72240	72310	72370	72430	72500	72560	72620	72680	72750	72810	630.0
31.30	72870	72940	73000	73060	73120	73190	73250	73310	73380	73440	630.0
31.40	73500	73570	73630	73690	73760	73820	73880	73950	74010	74070	640.0
31.50	74140	74200	74260	74330	74390	74450	74520	74580	74640	74710	630.0
31.60	74770	74840	74900	74960	75030	75090	75150	75220	75280	75350	640.0
31.70	75410	75480	75540	75600	75670	75730	75800	75860	75920	75990	640.0
31.80	76050	76120	76180	76250	76310	76380	76440	76500	76570	76630	650.0
31.90	76700	76760	76830	76890	76960	77020	77090	77150	77220	77280	650.0
32.00	77350	77410	77480	77540	77610	77670	77740	77800	77870	77930	650.0
32.10	78000	78060	78130	78190	78260	78330	78390	78460	78520	78590	650.0
32.20	78650	78720	78780	78850	78920	78980	79050	79110	79180	79240	660.0
32.30	79310	79380	79440	79510	79570	79640	79710	79770	79840	79910	660.0

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION
PRIMARY COMPUTATION OF GAGE HEIGHT AND DISCHARGE
DATE PROCESSED 03/30/88 COMPUTER OPERATOR AJA

VERSION 2200VP-03/19/64

11446500 AMERICAN RIVER AT FAIR OAKS

USED RATING 29

PROVISIONAL DATA FOR WATER YEAR ENDING SEPT. 30, 1986

DAY	DATE	MAX GH (TIME)	MIN GH (TIME)	MEAN GH	MAX DISCH SHIFT	MEAN DISCH	HOUR		1	2	3	4	5	6	7	8	9	10	11	12
135	2/12	7.31	7.07	7.19	4690.00	4470.00		AM	715	719	721	714	717	721	721	719	717	715	712	712
		(1745)	(1500)		+0.52			PM	711	709	707	725	722	731	727	725	724	722	723	725
136	2/13	10.31	7.21	7.91	12100.00	6050.00		AM	728	722	725	728	723	726	726	726	722	731	731	750
		(2330)	(145)		+0.48			PM	758	764	779	792	803	803	819	838	882	966	1030	1001
137	2/14	12.60	10.92	11.55	20100.00	16200.00		AM	1123	1138	1139	1139	1138	1138	1138	1136	1137	1136	1136	1132
		(2215)	(15)		+0.42			PM	1132	1131	1132	1133	1132	1133	1133	1202	1203	1259	1259	1260
138	2/15	12.77	12.37	12.61	20800.00	20200.00		AM	1260	1257	1258	1259	1261	1260	1263	1264	1265	1264	1264	1263
		(1600)	(1530)		+0.41			PM	1260	1259	1259	1277	1262	1261	1250	1260	1260	1260	1260	1259
139	2/16	18.24	12.47	13.98	48900.00	26700.00		AM	1260	1261	1260	1259	1258	1257	1257	1257	1257	1257	1256	1255
		(2400)	(1300)		+0.14			PM	1247	1308	1369	1420	1474	1518	1564	1617	1658	1740	1810	1824
140	2/17	26.70	18.17	22.25	120000.00	80100.00		AM	1825	1823	1820	1852	1880	1881	1957	1988	2031	2038	2093	2177
		(2245)	(315)		-0.01			PM	2243	2338	2366	2455	2477	2567	2589	2646	2659	2668	2648	2644
141	2/18	27.76	26.23	27.03	132000.00	124000.00		AM	2634	2636	2647	2648	2635	2627	2639	2676	2702	2711	2736	2740
		(2300)	(630)		-0.01			PM	2741	2742	2739	2712	2717	2720	2728	2735	2745	2764	2776	2772
142	2/19	27.96	27.35	27.70	135000.00	131000.00		AM	2766	2761	2766	2750	2740	2735	2758	2780	2787	2788	2784	2784
		(1315)	(600)		+0.00			PM	2789	2788	2791	2785	2779	2771	2761	2773	2755	2760	2743	2742
143	2/20	27.61	24.57	26.11	130000.00	114000.00		AM	2754	2747	2745	2749	2744	2741	2704	2701	2661	2644	2611	2597
		(15)	(2345)		+0.00			PM	2568	2557	2547	2534	2533	2524	2523	2517	2481	2467	2470	2464
144	2/21	24.69	19.55	22.76	99100.00	82400.00		AM	2466	2465	2463	2461	2418	2415	2421	2420	2336	2373	2316	2315
		(15)	(2400)		+0.00			PM	2272	2263	2238	2197	2142	2133	2138	2086	2063	2096	1998	1955
145	2/22	19.66	17.71	18.16	57700.00	47400.00		AM	1966	1886	1866	1844	1810	1810	1794	1812	1316	1908	1796	1796
		(100)	(1930)		+0.00			PM	1792	1791	1810	1808	1793	1791	1770	1787	1797	1794	1788	1813
146	2/23	18.09	16.54	17.70	46900.00	44400.00		AM	1794	1782	1785	1783	1783	1791	1797	1800	1780	1795	1803	1778
		(1430)	(2215)		+0.00			PM	1781	1786	1798	1783	1907	1804	1775	1738	1729	1707	1674	1668
147	2/24	16.70	15.15	15.49	38400.00	31700.00		AM	1670	1646	1606	1590	1593	1577	1534	1533	1535	1529	1530	1523
		(100)	(2300)		+0.00			PM	1527	1524	1526	1523	1522	1522	1522	1518	1521	1521	1515	1518

PERIOD 27.76 7.07

***** MAXIMUM GAGE HEIGHT FOR DAY IS BELOW PZF.
????????? GAGE HEIGHT EXCEEDS RATING TABLE.
!!!!!!!!! GAGE HEIGHT BELOW RATING TABLE.
V - INDICATES MORE THAN ONE SHIFT USED DURING THE DAY.
W(#) - STAGE/SHIFT DIAGRAM AND NO.(#) ON FILE FOR DAY.
G - GHT CORRECTION ON FILE FOR THIS DAY

1986 WATER YEAR

WATER-DAY NUMBER 135 FEB12

HOUR	G.H.	DISCHARGE (15)	G.H.	DISCHARGE (30)	G.H.	DISCHARGE (45)	G.H.	DISCHARGE (60)	HOUR
0	7.20	4.490E+03	7.17	4.435E+03	7.16	4.416E+03	7.15	4.398E+03	1
1	7.17	4.435E+03	7.18	4.453E+03	7.18	4.453E+03	7.19	4.471E+03	2
2	7.20	4.490E+03	7.20	4.490E+03	7.21	4.508E+03	7.21	4.508E+03	3
3	7.20	4.490E+03	7.16	4.416E+03	7.13	4.362E+03	7.14	4.380E+03	4
4	7.15	4.398E+03	7.17	4.435E+03	7.17	4.435E+03	7.17	4.435E+03	5
5	7.17	4.435E+03	7.19	4.471E+03	7.19	4.471E+03	7.21	4.508E+03	6
6	7.22	4.527E+03	7.21	4.508E+03	7.21	4.508E+03	7.21	4.508E+03	7
7	7.21	4.508E+03	7.21	4.508E+03	7.19	4.471E+03	7.19	4.471E+03	8
8	7.20	4.490E+03	7.19	4.471E+03	7.17	4.435E+03	7.17	4.435E+03	9
9	7.16	4.416E+03	7.17	4.435E+03	7.15	4.398E+03	7.15	4.398E+03	10
10	7.14	4.380E+03	7.13	4.362E+03	7.12	4.343E+03	7.12	4.343E+03	11
11	7.12	4.343E+03	7.12	4.343E+03	7.13	4.362E+03	7.12	4.343E+03	12
12	7.11	4.325E+03	7.11	4.325E+03	7.12	4.343E+03	7.11	4.325E+03	13
13	7.11	4.325E+03	7.11	4.325E+03	7.09	4.289E+03	7.09	4.289E+03	14
14	7.08	4.271E+03	7.08	4.271E+03	7.08	4.271E+03	7.07	4.253E+03	15
15	7.17	4.435E+03	7.25	4.582E+03	7.25	4.582E+03	7.25	4.582E+03	16
16	7.26	4.601E+03	7.25	4.582E+03	7.23	4.545E+03	7.22	4.527E+03	17
17	7.23	4.545E+03	7.26	4.601E+03	7.31	4.694E+03	7.31	4.694E+03	18
18	7.30	4.676E+03	7.26	4.601E+03	7.27	4.619E+03	7.27	4.619E+03	19
19	7.25	4.582E+03	7.24	4.564E+03	7.24	4.564E+03	7.25	4.582E+03	20
20	7.23	4.545E+03	7.25	4.582E+03	7.25	4.582E+03	7.24	4.564E+03	21
21	7.24	4.564E+03	7.22	4.527E+03	7.23	4.545E+03	7.22	4.527E+03	22
22	7.22	4.527E+03	7.22	4.527E+03	7.23	4.545E+03	7.23	4.545E+03	23
23	7.25	4.582E+03	7.23	4.545E+03	7.25	4.582E+03	7.25	4.582E+03	24

WATER-DAY NUMBER 136 13th

HOUR	G.H.	DISCHARGE (15)	G.H.	DISCHARGE (30)	G.H.	DISCHARGE (45)	G.H.	DISCHARGE (60)	HOUR
0	7.28	4.638E+03	7.29	4.657E+03	7.29	4.657E+03	7.28	4.638E+03	1
1	7.28	4.638E+03	7.26	4.601E+03	7.21	4.508E+03	7.22	4.527E+03	2
2	7.24	4.564E+03	7.23	4.545E+03	7.24	4.564E+03	7.25	4.582E+03	3
3	7.27	4.619E+03	7.27	4.619E+03	7.27	4.619E+03	7.28	4.638E+03	4
4	7.29	4.657E+03	7.29	4.657E+03	7.27	4.619E+03	7.23	4.545E+03	5
5	7.24	4.564E+03	7.25	4.582E+03	7.25	4.582E+03	7.26	4.601E+03	6
6	7.26	4.601E+03	7.27	4.619E+03	7.27	4.619E+03	7.26	4.601E+03	7
7	7.28	4.638E+03	7.27	4.619E+03	7.26	4.601E+03	7.26	4.601E+03	8
8	7.25	4.582E+03	7.25	4.582E+03	7.24	4.564E+03	7.22	4.527E+03	9
9	7.23	4.545E+03	7.28	4.638E+03	7.31	4.694E+03	7.31	4.694E+03	10
10	7.31	4.694E+03	7.29	4.657E+03	7.28	4.638E+03	7.31	4.694E+03	11
11	7.38	4.827E+03	7.46	4.981E+03	7.47	5.000E+03	7.50	5.059E+03	12
12	7.50	5.059E+03	7.56	5.176E+03	7.53	5.117E+03	7.58	5.216E+03	13
13	7.65	5.355E+03	7.69	5.436E+03	7.65	5.355E+03	7.64	5.335E+03	14
14	7.74	5.537E+03	7.79	5.640E+03	7.77	5.599E+03	7.79	5.640E+03	15
15	7.89	5.847E+03	7.92	5.910E+03	7.92	5.910E+03	7.92	5.910E+03	16
16	8.01	6.101E+03	8.03	6.144E+03	8.03	6.144E+03	8.03	6.144E+03	17
17	8.02	6.122E+03	8.03	6.144E+03	8.03	6.144E+03	8.03	6.144E+03	18
18	8.17	6.449E+03	8.19	6.493E+03	8.19	6.493E+03	8.19	6.493E+03	19
19	8.33	6.806E+03	8.38	6.919E+03	8.39	6.942E+03	8.38	6.919E+03	20
20	8.73	7.740E+03	8.80	7.909E+03	8.81	7.933E+03	8.82	7.958E+03	21
21	9.49	9.673E+03	9.61	1.000E+04	9.65	1.011E+04	9.66	1.014E+04	22
22	10.22	1.178E+04	10.28	1.197E+04	10.29	1.200E+04	10.30	1.203E+04	23
23	10.30	1.203E+04	10.31	1.206E+04	10.31	1.206E+04	10.31	1.206E+04	24

WATER-DAY NUMBER 137 14th

HOUR	G.H.	DISCHARGE (15)	G.H.	DISCHARGE (30)	G.H.	DISCHARGE (45)	G.H.	DISCHARGE (60)	HOUR
0	10.92	1.401E+04	11.16	1.481E+04	11.21	1.498E+04	11.23	1.505E+04	1
1	11.26	1.516E+04	11.34	1.543E+04	11.37	1.554E+04	11.38	1.557E+04	2
2	11.39	1.561E+04	11.39	1.561E+04	11.38	1.557E+04	11.39	1.561E+04	3
3	11.38	1.557E+04	11.38	1.557E+04	11.39	1.561E+04	11.39	1.561E+04	4
4	11.38	1.557E+04	11.38	1.557E+04	11.38	1.557E+04	11.38	1.557E+04	5
5	11.37	1.554E+04	11.38	1.557E+04	11.38	1.557E+04	11.38	1.557E+04	6
6	11.37	1.554E+04	11.38	1.557E+04	11.36	1.550E+04	11.38	1.557E+04	7
7	11.37	1.554E+04	11.37	1.554E+04	11.36	1.550E+04	11.36	1.550E+04	8
8	11.37	1.554E+04	11.37	1.554E+04	11.37	1.554E+04	11.37	1.554E+04	9
9	11.36	1.550E+04	11.36	1.550E+04	11.36	1.550E+04	11.36	1.550E+04	10
10	11.36	1.550E+04	11.36	1.550E+04	11.36	1.550E+04	11.36	1.550E+04	11
11	11.36	1.550E+04	11.32	1.536E+04	11.32	1.536E+04	11.32	1.536E+04	12
12	11.34	1.543E+04	11.33	1.540E+04	11.33	1.540E+04	11.32	1.536E+04	13
13	11.32	1.536E+04	11.32	1.536E+04	11.32	1.536E+04	11.31	1.533E+04	14
14	11.31	1.533E+04	11.32	1.536E+04	11.32	1.536E+04	11.32	1.536E+04	15
15	11.31	1.533E+04	11.31	1.533E+04	11.31	1.533E+04	11.33	1.540E+04	16
16	11.32	1.536E+04	11.32	1.536E+04	11.33	1.540E+04	11.32	1.536E+04	17
17	11.32	1.536E+04	11.33	1.540E+04	11.32	1.536E+04	11.33	1.540E+04	18
18	11.32	1.536E+04	11.33	1.540E+04	11.32	1.536E+04	11.33	1.540E+04	19
19	11.79	1.704E+04	11.98	1.774E+04	12.00	1.782E+04	12.02	1.789E+04	20
20	12.02	1.789E+04	12.02	1.789E+04	12.04	1.797E+04	12.03	1.793E+04	21
21	12.38	1.926E+04	12.55	1.993E+04	12.57	2.001E+04	12.59	2.009E+04	22
22	12.60	2.013E+04	12.60	2.013E+04	12.60	2.013E+04	12.59	2.009E+04	23
23	12.59	2.009E+04	12.60	2.013E+04	12.60	2.013E+04	12.60	2.013E+04	24

WATER-DAY NUMBER 138 15th

HOUR	G.H.	DISCHARGE (15)	G.H.	DISCHARGE (30)	G.H.	DISCHARGE (45)	G.H.	DISCHARGE (60)	HOUR
0	12.59	2.009E+04	12.60	2.013E+04	12.59	2.009E+04	12.60	2.013E+04	1
1	12.59	2.009E+04	12.59	2.009E+04	12.58	2.005E+04	12.59	2.009E+04	2
2	12.58	2.005E+04	12.57	2.001E+04	12.58	2.005E+04	12.58	2.005E+04	3
3	12.58	2.005E+04	12.59	2.009E+04	12.59	2.009E+04	12.59	2.009E+04	4
4	12.60	2.013E+04	12.60	2.013E+04	12.60	2.013E+04	12.61	2.017E+04	5
5	12.60	2.013E+04	12.60	2.013E+04	12.60	2.013E+04	12.60	2.013E+04	6
6	12.61	2.017E+04	12.61	2.017E+04	12.62	2.021E+04	12.63	2.025E+04	7
7	12.63	2.025E+04	12.64	2.029E+04	12.64	2.029E+04	12.64	2.029E+04	8
8	12.64	2.029E+04	12.64	2.029E+04	12.64	2.029E+04	12.65	2.033E+04	9
9	12.65	2.033E+04	12.65	2.033E+04	12.64	2.029E+04	12.64	2.029E+04	10
10	12.64	2.029E+04	12.64	2.029E+04	12.64	2.029E+04	12.64	2.029E+04	11
11	12.64	2.029E+04	12.64	2.029E+04	12.63	2.025E+04	12.63	2.025E+04	12
12	12.62	2.021E+04	12.60	2.013E+04	12.60	2.013E+04	12.60	2.013E+04	13
13	12.60	2.013E+04	12.60	2.013E+04	12.59	2.009E+04	12.59	2.009E+04	14
14	12.59	2.009E+04	12.59	2.009E+04	12.59	2.009E+04	12.59	2.009E+04	15
15	12.59	2.009E+04	12.37	1.923E+04	12.45	1.954E+04	12.77	2.081E+04	16
16	12.65	2.033E+04	12.63	2.025E+04	12.64	2.029E+04	12.62	2.021E+04	17
17	12.59	2.009E+04	12.60	2.013E+04	12.61	2.017E+04	12.61	2.017E+04	18
18	12.61	2.017E+04	12.60	2.013E+04	12.60	2.013E+04	12.60	2.013E+04	19
19	12.60	2.013E+04	12.60	2.013E+04	12.60	2.013E+04	12.60	2.013E+04	20
20	12.60	2.013E+04	12.60	2.013E+04	12.60	2.013E+04	12.60	2.013E+04	21
21	12.60	2.013E+04	12.60	2.013E+04	12.60	2.013E+04	12.60	2.013E+04	22
22	12.60	2.013E+04	12.60	2.013E+04	12.60	2.013E+04	12.60	2.013E+04	23
23	12.60	2.013E+04	12.60	2.013E+04	12.60	2.013E+04	12.59	2.009E+04	24

WATER-DAY NUMBER 139 16th

HOUR	G.H.	DISCHARGE (15)	G.H.	DISCHARGE (30)	G.H.	DISCHARGE (45)	G.H.	DISCHARGE (60)	HOUR
0	12.61	2.017E+04	12.60	2.013E+04	12.59	2.009E+04	12.60	2.013E+04	1
1	12.59	2.009E+04	12.60	2.013E+04	12.60	2.013E+04	12.61	2.017E+04	2
2	12.61	2.017E+04	12.61	2.017E+04	12.61	2.017E+04	12.60	2.013E+04	3
3	12.60	2.013E+04	12.59	2.009E+04	12.59	2.009E+04	12.59	2.009E+04	4
4	12.59	2.009E+04	12.60	2.013E+04	12.59	2.009E+04	12.58	2.005E+04	5
5	12.59	2.009E+04	12.59	2.009E+04	12.58	2.005E+04	12.57	2.001E+04	6
6	12.58	2.005E+04	12.58	2.005E+04	12.58	2.005E+04	12.57	2.001E+04	7
7	12.57	2.001E+04	12.57	2.001E+04	12.58	2.005E+04	12.57	2.001E+04	8
8	12.58	2.005E+04	12.57	2.001E+04	12.57	2.001E+04	12.57	2.001E+04	9
9	12.57	2.001E+04	12.57	2.001E+04	12.56	1.997E+04	12.57	2.001E+04	10
10	12.57	2.001E+04	12.57	2.001E+04	12.55	1.993E+04	12.56	1.997E+04	11
11	12.56	1.997E+04	12.56	1.997E+04	12.56	1.997E+04	12.55	1.993E+04	12
12	12.56	1.997E+04	12.56	1.997E+04	12.56	1.997E+04	12.47	1.962E+04	13
13	13.00	2.175E+04	13.09	2.212E+04	13.09	2.212E+04	13.08	2.208E+04	14
14	13.52	2.395E+04	13.65	2.452E+04	13.69	2.469E+04	13.69	2.469E+04	15
15	13.95	2.585E+04	14.15	2.676E+04	14.20	2.699E+04	14.20	2.699E+04	16
16	14.54	2.857E+04	14.68	2.924E+04	14.72	2.943E+04	14.74	2.953E+04	17
17	15.11	3.133E+04	15.16	3.158E+04	15.17	3.163E+04	15.18	3.168E+04	18
18	15.49	3.324E+04	15.59	3.376E+04	15.60	3.381E+04	15.64	3.402E+04	19
19	15.91	3.543E+04	16.01	3.597E+04	16.07	3.629E+04	16.17	3.682E+04	20
20	16.16	3.677E+04	16.48	3.852E+04	16.53	3.879E+04	16.58	3.907E+04	21
21	17.15	4.231E+04	17.29	4.312E+04	17.37	4.359E+04	17.40	4.377E+04	22
22	17.38	4.365E+04	17.99	4.731E+04	18.10	4.799E+04	18.10	4.799E+04	23
23	18.18	4.848E+04	18.18	4.848E+04	18.20	4.861E+04	18.24	4.885E+04	24

WATER-DAY NUMBER 140 17th

HOUR	G.H.	DISCHARGE (15)	G.H.	DISCHARGE (30)	G.H.	DISCHARGE (45)	G.H.	DISCHARGE (60)	HOUR
0	18.24	4.790E+04	18.29	4.823E+04	18.29	4.823E+04	18.25	4.796E+04	1
1	18.29	4.823E+04	18.24	4.790E+04	18.25	4.796E+04	18.23	4.783E+04	2
2	18.23	4.783E+04	18.20	4.764E+04	18.21	4.770E+04	18.20	4.764E+04	3
3	18.17	4.744E+04	18.20	4.764E+04	18.22	4.777E+04	18.52	4.975E+04	4
4	18.75	5.130E+04	18.74	5.123E+04	18.75	5.130E+04	18.80	5.164E+04	5
5	18.80	5.164E+04	18.77	5.144E+04	18.79	5.157E+04	18.81	5.171E+04	6
6	19.20	5.441E+04	19.40	5.582E+04	19.49	5.646E+04	19.57	5.704E+04	7
7	19.57	5.704E+04	19.59	5.718E+04	19.58	5.711E+04	19.88	5.929E+04	8
8	20.20	6.166E+04	20.23	6.189E+04	20.30	6.242E+04	20.31	6.249E+04	9
9	20.37	6.295E+04	20.33	6.264E+04	20.37	6.295E+04	20.38	6.302E+04	10
10	20.81	6.626E+04	20.87	6.672E+04	20.89	6.687E+04	20.93	6.717E+04	11
11	21.22	6.941E+04	21.33	7.026E+04	21.62	7.255E+04	21.77	7.374E+04	12
12	21.98	7.543E+04	22.12	7.657E+04	22.19	7.715E+04	22.43	7.913E+04	13
13	23.05	8.437E+04	23.21	8.575E+04	23.32	8.670E+04	23.38	8.723E+04	14
14	23.50	8.828E+04	23.55	8.872E+04	23.62	8.934E+04	23.66	8.969E+04	15
15	23.71	9.014E+04	23.96	9.238E+04	24.35	9.593E+04	24.55	9.777E+04	16
16	24.62	9.842E+04	24.68	9.898E+04	24.71	9.926E+04	24.77	9.982E+04	17
17	24.86	1.006E+05	25.16	1.036E+05	25.57	1.078E+05	25.67	1.089E+05	18
18	25.72	1.094E+05	25.78	1.100E+05	25.83	1.106E+05	25.89	1.112E+05	19
19	25.97	1.121E+05	26.17	1.142E+05	26.34	1.161E+05	26.46	1.174E+05	20
20	26.43	1.170E+05	26.45	1.173E+05	26.50	1.178E+05	26.59	1.188E+05	21
21	26.57	1.186E+05	26.64	1.194E+05	26.64	1.194E+05	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]							

HOUR	G.H.	DISCHARGE (15)	G.H.	DISCHARGE (30)	G.H.	DISCHARGE (45)	G.H.	DISCHARGE (60)	HOUR
0	26.40	1.167E+05	26.36	1.162E+05	26.33	1.159E+05	26.34	1.161E+05	1
1	26.25	1.151E+05	26.27	1.153E+05	26.33	1.159E+05	26.36	1.163E+05	2
2	26.45	1.173E+05	26.46	1.174E+05	26.40	1.170E+05	26.47	1.175E+05	3
3	26.49	1.177E+05	26.45	1.173E+05	26.46	1.174E+05	26.48	1.176E+05	4
4	26.34	1.161E+05	26.33	1.159E+05	26.36	1.163E+05	26.35	1.162E+05	5
5	26.33	1.159E+05	26.31	1.157E+05	26.28	1.154E+05	26.27	1.153E+05	6
6	26.29	1.155E+05	26.23	1.149E+05	26.27	1.153E+05	26.39	1.166E+05	7
7	26.65	1.195E+05	26.68	1.198E+05	26.81	1.212E+05	26.76	1.207E+05	8
8	26.75	1.206E+05	26.97	1.230E+05	27.01	1.235E+05	27.02	1.236E+05	9
9	27.04	1.238E+05	27.11	1.246E+05	27.15	1.251E+05	27.11	1.246E+05	10
10	27.09	1.244E+05	27.16	1.252E+05	27.25	1.262E+05	27.36	1.275E+05	11
11	27.33	1.271E+05	27.37	1.276E+05	27.38	1.277E+05	27.40	1.279E+05	12
12	27.40	1.279E+05	27.47	1.287E+05	27.40	1.279E+05	27.41	1.281E+05	13
13	27.39	1.278E+05	27.41	1.281E+05	27.40	1.279E+05	27.42	1.282E+05	14
14	27.44	1.284E+05	27.48	1.289E+05	27.43	1.283E+05	27.39	1.278E+05	15
15	27.34	1.273E+05	27.14	1.250E+05	27.24	1.261E+05	27.12	1.247E+05	16
16	27.08	1.243E+05	27.13	1.249E+05	27.10	1.245E+05	27.17	1.253E+05	17
17	27.14	1.250E+05	27.14	1.250E+05	27.22	1.259E+05	27.20	1.256E+05	18
18	27.23	1.260E+05	27.25	1.262E+05	27.24	1.261E+05	27.28	1.266E+05	19
19	27.30	1.268E+05	27.32	1.270E+05	27.37	1.276E+05	27.35	1.274E+05	20
20	27.38	1.277E+05	27.49	1.290E+05	27.48	1.289E+05	27.45	1.285E+05	21
21	27.49	1.290E+05	27.57	1.299E+05	27.61	1.304E+05	27.64	1.307E+05	22
22	27.65	1.308E+05	27.67	1.311E+05	27.66	1.310E+05	27.76	1.321E+05	23
23	27.67	1.311E+05	27.72	1.317E+05	27.71	1.315E+05	27.72	1.317E+05	24

WATER-DAY NUMBER 142 19th

HOUR	G.H.	DISCHARGE (15)	G.H.	DISCHARGE (30)	G.H.	DISCHARGE (45)	G.H.	DISCHARGE (60)	HOUR
0	27.61	1.304E+05	27.68	1.312E+05	27.69	1.313E+05	27.66	1.310E+05	1
1	27.62	1.305E+05	27.73	1.318E+05	27.65	1.308E+05	27.61	1.304E+05	2
2	27.66	1.310E+05	27.65	1.308E+05	27.69	1.313E+05	27.66	1.310E+05	3
3	27.64	1.307E+05	27.58	1.300E+05	27.55	1.297E+05	27.50	1.291E+05	4
4	27.45	1.285E+05	27.47	1.287E+05	27.45	1.285E+05	27.40	1.279E+05	5
5	27.41	1.281E+05	27.41	1.281E+05	27.38	1.277E+05	27.35	1.274E+05	6
6	27.48	1.289E+05	27.61	1.304E+05	27.59	1.301E+05	27.58	1.300E+05	7
7	27.68	1.312E+05	27.66	1.310E+05	27.73	1.318E+05	27.80	1.326E+05	8
8	27.65	1.308E+05	27.82	1.328E+05	27.80	1.326E+05	27.87	1.334E+05	9
9	27.77	1.322E+05	27.80	1.326E+05	27.82	1.328E+05	27.88	1.335E+05	10
10	27.84	1.331E+05	27.93	1.341E+05	27.83	1.329E+05	27.84	1.331E+05	11
11	27.80	1.326E+05	27.84	1.331E+05	27.88	1.335E+05	27.84	1.331E+05	12
12	27.81	1.327E+05	27.89	1.336E+05	27.88	1.335E+05	27.89	1.336E+05	13
13	27.96	1.345E+05	27.83	1.329E+05	27.89	1.336E+05	27.88	1.335E+05	14
14	27.92	1.340E+05	27.96	1.345E+05	27.83	1.329E+05	27.91	1.339E+05	15
15	27.89	1.336E+05	27.92	1.340E+05	27.85	1.332E+05	27.85	1.332E+05	16
16	27.87	1.334E+05	27.87	1.334E+05	27.77	1.322E+05	27.79	1.325E+05	17
17	27.76	1.321E+05	27.64	1.307E+05	27.68	1.312E+05	27.71	1.315E+05	18
18	27.71	1.315E+05	27.72	1.317E+05	27.65	1.308E+05	27.61	1.304E+05	19
19	27.65	1.308E+05	27.66	1.310E+05	27.73	1.318E+05	27.73	1.318E+05	20
20	27.73	1.318E+05	27.66	1.310E+05	27.67	1.311E+05	27.55	1.297E+05	21
21	27.69	1.313E+05	27.69	1.313E+05	27.66	1.310E+05	27.60	1.303E+05	22
22	27.55	1.297E+05	27.66	1.310E+05	27.59	1.301E+05	27.43	1.283E+05	23
23	27.59	1.301E+05	27.53	1.294E+05	27.47	1.287E+05	27.42	1.282E+05	24

	(15)		(30)		(45)		(60)	
0	27.61	1.304E+05	27.55	1.297E+05	27.54	1.296E+05	27.54	1.296E+05	1
1	27.43	1.283E+05	27.44	1.284E+05	27.39	1.273E+05	27.47	1.287E+05	2
2	27.40	1.279E+05	27.40	1.279E+05	27.37	1.276E+05	27.45	1.285E+05	3
3	27.51	1.292E+05	27.47	1.287E+05	27.48	1.289E+05	27.49	1.290E+05	4
4	27.38	1.277E+05	27.48	1.289E+05	27.50	1.291E+05	27.44	1.284E+05	5
5	27.44	1.284E+05	27.41	1.281E+05	27.47	1.287E+05	27.41	1.281E+05	6
6	27.21	1.258E+05	27.12	1.247E+05	27.04	1.238E+05	27.04	1.238E+05	7
7	27.00	1.234E+05	26.97	1.230E+05	27.07	1.242E+05	27.01	1.235E+05	8
8	26.83	1.215E+05	26.71	1.201E+05	26.77	1.208E+05	26.61	1.190E+05	9
9	26.61	1.190E+05	26.66	1.196E+05	26.61	1.190E+05	26.44	1.172E+05	10
10	26.19	1.144E+05	26.08	1.132E+05	26.12	1.137E+05	26.11	1.136E+05	11
11	26.10	1.135E+05	26.13	1.138E+05	26.04	1.128E+05	25.97	1.121E+05	12
12	25.79	1.101E+05	25.78	1.100E+05	25.69	1.091E+05	25.68	1.090E+05	13
13	25.66	1.088E+05	25.62	1.084E+05	25.52	1.073E+05	25.57	1.078E+05	14
14	25.59	1.080E+05	25.53	1.074E+05	25.49	1.070E+05	25.47	1.068E+05	15
15	25.48	1.069E+05	25.36	1.056E+05	25.50	1.071E+05	25.34	1.054E+05	16
16	25.46	1.067E+05	25.38	1.058E+05	25.36	1.056E+05	25.33	1.053E+05	17
17	25.33	1.053E+05	25.25	1.045E+05	25.28	1.048E+05	25.24	1.044E+05	18
18	25.28	1.048E+05	25.20	1.040E+05	25.17	1.037E+05	25.23	1.043E+05	19
19	25.24	1.044E+05	25.15	1.035E+05	25.15	1.035E+05	25.17	1.037E+05	20
20	24.99	1.019E+05	24.83	1.003E+05	24.83	1.003E+05	24.81	1.002E+05	21
21	24.75	9.964E+04	24.86	1.006E+05	24.70	9.917E+04	24.67	9.889E+04	22
22	24.68	9.898E+04	24.67	9.889E+04	24.65	9.870E+04	24.70	9.917E+04	23
23	24.67	9.889E+04	24.70	9.917E+04	24.57	9.796E+04	24.64	9.861E+04	24

WATER-DAY NUMBER 144 21ST

HOUR	G.H.	DISCHARGE (15)	G.H.	DISCHARGE (30)	G.H.	DISCHARGE (45)	G.H.	DISCHARGE (60)	HOUR
0	24.69	9.908E+04	24.57	9.796E+04	24.68	9.898E+04	24.66	9.880E+04	1
1	24.62	9.842E+04	24.65	9.870E+04	24.63	9.852E+04	24.65	9.870E+04	2
2	24.69	9.908E+04	24.58	9.805E+04	24.62	9.842E+04	24.63	9.852E+04	3
3	24.66	9.880E+04	24.59	9.814E+04	24.65	9.870E+04	24.61	9.833E+04	4
4	24.41	9.648E+04	24.23	9.483E+04	24.19	9.446E+04	24.18	9.437E+04	5
5	24.15	9.410E+04	24.18	9.437E+04	24.25	9.501E+04	24.15	9.410E+04	6
6	24.26	9.510E+04	24.16	9.419E+04	24.16	9.419E+04	24.21	9.464E+04	7
7	24.14	9.401E+04	24.28	9.528E+04	24.19	9.446E+04	24.20	9.455E+04	8
8	24.17	9.428E+04	24.20	9.455E+04	24.06	9.328E+04	23.86	9.148E+04	9
9	23.78	9.076E+04	23.75	9.049E+04	23.69	8.996E+04	23.73	9.032E+04	10
10	23.66	8.969E+04	23.44	8.775E+04	23.30	8.653E+04	23.16	8.532E+04	11
11	23.21	8.575E+04	23.20	8.566E+04	23.15	8.523E+04	23.15	8.523E+04	12
12	23.11	8.488E+04	23.11	8.488E+04	[illegible]	[illegible]	22.72	8.156E+04	13
13	22.66	8.105E+04	22.65	8.097E+04	22.66	8.105E+04	22.63	8.080E+04	14
14	22.53	7.996E+04	22.63	8.080E+04	22.55	8.013E+04	22.38	7.871E+04	15
15	22.09	7.633E+04	22.02	7.576E+04	22.02	7.576E+04	21.97	7.535E+04	16
16	21.97	7.535E+04	21.91	7.487E+04	21.90	7.479E+04	21.62	7.255E+04	17
17	21.39	7.073E+04	21.44	7.112E+04	21.35	7.042E+04	21.33	7.026E+04	18
18	21.31	7.011E+04	21.28	6.987E+04	21.34	7.034E+04	21.38	7.065E+04	19
19	21.00	6.771E+04	20.87	6.672E+04	20.81	6.626E+04	20.86	6.664E+04	20
20	20.75	6.581E+04	20.87	6.672E+04	20.83	6.641E+04	20.63	6.491E+04	21
21	20.49	6.386E+04	20.31	6.249E+04	20.21	6.174E+04	20.26	6.211E+04	22
22	20.23	6.189E+04	20.24	6.196E+04	20.10	6.092E+04	19.98	6.003E+04	23
23	19.76	5.841E+04	19.57	5.704E+04	19.61	5.732E+04	19.55	5.689E+04	24

HOUR	G.H.	DISCHARGE (15)	G.H.	DISCHARGE (30)	G.H.	DISCHARGE (45)	G.H.	DISCHARGE (60)	HOUR
0	19.64	5.754E+04	19.43	5.603E+04	19.58	5.711E+04	19.66	5.769E+04	1
1	19.32	5.525E+04	19.15	5.406E+04	19.27	5.490E+04	18.86	5.205E+04	2
2	19.04	5.329E+04	18.77	5.144E+04	19.11	5.373E+04	18.66	5.069E+04	3
3	18.37	4.875E+04	18.69	5.089E+04	18.79	5.157E+04	18.44	4.922E+04	4
4	18.09	4.692E+04	18.22	4.777E+04	18.08	4.686E+04	18.10	4.699E+04	5
5	18.28	4.816E+04	18.02	4.647E+04	17.97	4.615E+04	18.10	4.699E+04	6
6	18.21	4.770E+04	18.02	4.647E+04	18.17	4.744E+04	17.94	4.596E+04	7
7	18.09	4.692E+04	18.02	4.647E+04	18.06	4.673E+04	18.12	4.712E+04	8
8	18.00	4.634E+04	17.91	4.576E+04	18.00	4.634E+04	18.16	4.738E+04	9
9	18.14	4.725E+04	18.10	4.699E+04	18.02	4.647E+04	18.08	4.686E+04	10
10	17.96	4.608E+04	18.05	4.666E+04	17.98	4.621E+04	17.96	4.608E+04	11
11	18.01	4.640E+04	18.12	4.712E+04	17.83	4.525E+04	17.96	4.608E+04	12
12	17.99	4.628E+04	18.00	4.634E+04	17.98	4.621E+04	17.92	4.583E+04	13
13	17.99	4.628E+04	17.73	4.462E+04	18.15	4.731E+04	17.91	4.576E+04	14
14	17.82	4.519E+04	18.03	4.653E+04	18.09	4.692E+04	18.10	4.699E+04	15
15	18.00	4.634E+04	18.04	4.660E+04	17.99	4.628E+04	18.08	4.686E+04	16
16	17.94	4.596E+04	17.77	4.487E+04	17.87	4.551E+04	17.93	4.589E+04	17
17	17.92	4.583E+04	17.99	4.628E+04	17.89	4.564E+04	17.91	4.576E+04	18
18	17.91	4.576E+04	17.75	4.475E+04	17.79	4.500E+04	17.90	4.570E+04	19
19	17.89	4.564E+04	17.71	4.449E+04	17.94	4.596E+04	17.87	4.551E+04	20
20	17.75	4.475E+04	17.81	4.513E+04	17.92	4.583E+04	17.87	4.551E+04	21
21	18.03	4.653E+04	18.01	4.640E+04	17.86	4.544E+04	17.94	4.596E+04	22
22	17.93	4.589E+04	17.93	4.589E+04	17.91	4.576E+04	17.88	4.557E+04	23
23	17.94	4.596E+04	18.05	4.666E+04	18.02	4.647E+04	18.13	4.718E+04	24

23rd

WATER-DAY NUMBER 146

HOUR	G.H.	DISCHARGE (15)	G.H.	DISCHARGE (30)	G.H.	DISCHARGE (45)	G.H.	DISCHARGE (60)	HOUR
0	17.93	4.589E+04	17.81	4.513E+04	17.88	4.557E+04	17.94	4.596E+04	1
1	17.82	4.519E+04	17.84	4.532E+04	17.98	4.621E+04	17.82	4.519E+04	2
2	17.87	4.551E+04	17.95	4.602E+04	17.96	4.608E+04	17.85	4.538E+04	3
3	18.07	4.679E+04	17.68	4.431E+04	17.97	4.615E+04	17.83	4.525E+04	4
4	18.05	4.666E+04	17.86	4.544E+04	17.87	4.551E+04	17.83	4.525E+04	5
5	17.95	4.602E+04	17.90	4.570E+04	17.75	4.475E+04	17.91	4.576E+04	6
6	17.84	4.532E+04	17.75	4.475E+04	18.03	4.653E+04	17.97	4.615E+04	7
7	17.98	4.621E+04	17.87	4.551E+04	17.85	4.538E+04	18.00	4.634E+04	8
8	17.69	4.437E+04	17.97	4.615E+04	17.84	4.532E+04	17.80	4.506E+04	9
9	17.82	4.519E+04	18.01	4.640E+04	17.85	4.538E+04	17.95	4.602E+04	10
10	17.91	4.576E+04	17.87	4.551E+04	17.88	4.557E+04	18.03	4.653E+04	11
11	17.99	4.628E+04	17.99	4.628E+04	17.84	4.532E+04	17.78	4.494E+04	12
12	17.90	4.570E+04	17.92	4.583E+04	17.84	4.532E+04	17.81	4.513E+04	13
13	17.95	4.602E+04	17.77	4.487E+04	17.84	4.532E+04	17.86	4.544E+04	14
14	17.67	4.424E+04	18.09	4.692E+04	17.99	4.628E+04	17.88	4.557E+04	15
15	17.87	4.551E+04	17.88	4.557E+04	17.94	4.596E+04	17.83	4.525E+04	16
16	17.87	4.551E+04	18.02	4.647E+04	17.99	4.628E+04	18.07	4.679E+04	17
17	17.84	4.532E+04	17.91	4.576E+04	17.81	4.513E+04	18.04	4.660E+04	18
18	17.56	4.356E+04	17.27	4.177E+04	17.37	4.238E+04	17.35	4.226E+04	19
19	17.46	4.294E+04	17.29	4.189E+04	17.43	4.275E+04	17.38	4.244E+04	20
20	17.29	4.189E+04	17.29	4.189E+04	17.16	4.110E+04	17.29	4.189E+04	21
21	17.45	4.287E+04	17.37	4.238E+04	17.16	4.110E+04	17.07	4.056E+04	22
22	16.82	3.908E+04	16.56	3.757E+04	16.62	3.791E+04	16.74	3.861E+04	23
23	16.54	3.745E+04	16.67	3.820E+04	16.66	3.814E+04	16.68	3.826E+04	24

WATER-DAY NUMBER 147

HOUR	G.H.	DISCHARGE (15)	G.H.	DISCHARGE (30)	G.H.	DISCHARGE (45)	G.H.	DISCHAR (60)
0	16.60	3.780E+04	16.53	3.740E+04	16.62	3.791E+04	16.70	3.838E+
1	16.63	3.797E+04	16.51	3.728E+04	16.59	3.774E+04	16.46	3.699E+
2	16.29	3.603E+04	15.99	3.437E+04	16.01	3.448E+04	16.06	3.475E+
3	16.00	3.442E+04	15.96	3.420E+04	15.85	3.360E+04	15.90	3.387E+
4	16.01	3.448E+04	15.99	3.437E+04	16.05	3.470E+04	15.93	3.404E+0
5	15.95	3.415E+04	15.89	3.382E+04	15.92	3.398E+04	15.79	3.328E+0
6	15.60	3.226E+04	15.32	3.080E+04	15.39	3.116E+04	15.34	3.090E+0
7	15.35	3.095E+04	15.34	3.090E+04	15.33	3.085E+04	15.33	3.085E+0
8	15.32	3.080E+04	15.33	3.085E+04	15.34	3.090E+04	15.35	3.095E+0
9	15.33	3.085E+04	15.32	3.080E+04	15.30	3.069E+04	15.29	3.064E+0
10	15.32	3.080E+04	15.30	3.069E+04	15.30	3.069E+04	15.30	3.069E+0
11	15.26	3.049E+04	15.29	3.064E+04	15.29	3.064E+04	15.28	3.059E+0
12	15.26	3.049E+04	15.27	3.054E+04	15.27	3.054E+04	15.27	3.054E+0
13	15.27	3.054E+04	15.25	3.044E+04	15.26	3.049E+04	15.24	3.038E+0
14	15.25	3.044E+04	15.27	3.054E+04	15.26	3.049E+04	15.26	3.049E+0
15	15.25	3.044E+04	15.25	3.044E+04	15.24	3.038E+04	15.23	3.033E+0
16	15.23	3.033E+04	15.24	3.038E+04	15.23	3.033E+04	15.22	3.028E+0
17	15.23	3.033E+04	15.22	3.028E+04	15.23	3.033E+04	15.22	3.028E+0
18	15.23	3.033E+04	15.21	3.023E+04	15.23	3.033E+04	15.22	3.028E+0
19	15.21	3.023E+04	15.21	3.023E+04	15.21	3.023E+04	15.18	3.008E+04
20	15.20	3.018E+04	15.19	3.013E+04	15.20	3.018E+04	15.21	3.023E+04
21	15.19	3.013E+04	15.18	3.008E+04	15.19	3.013E+04	15.21	3.023E+04
22	15.18	3.008E+04	15.17	3.003E+04	15.17	3.003E+04	15.15	2.992E+04
23	15.17	3.003E+04	15.16	2.998E+04	15.17	3.003E+04	15.18	3.008E+04

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13FEB86, 1300;	5216.0	5335.0	5640.0	5910.0	6144.0	6144.0
13FEB86, 1900;	6493.0	6919.0	7958.0	10140.0	12030.0	12060.0
14FEB86, 0100;	15050.0	10140.0	15610.0	15610.0	10140.0	10140.0
14FEB86, 0700;	15570.0	15500.0	15500.0	15540.0	15500.0	15360.0
14FEB86, 1300;	15360.0	15330.0	15360.0	15400.0	15360.0	15400.0
14FEB86, 1900;	15400.0	17890.0	17930.0	20090.0	20090.0	20130.0
15FEB86, 0100;	20130.0	20090.0	20050.0	20090.0	20170.0	20130.0
15FEB86, 0700;	20250.0	20290.0	20330.0	20290.0	20290.0	20250.0
15FEB86, 1300;	20130.0	20090.0	20090.0	20810.0	20210.0	20170.0
15FEB86, 1900;	20130.0	20130.0	20130.0	20130.0	20130.0	20090.0
16FEB86, 0100;	20130.0	20170.0	20130.0	20090.0	20050.0	20010.0
16FEB86, 0700;	20010.0	20010.0	20010.0	20010.0	19970.0	19930.0
16FEB86, 1300;	19620.0	22080.0	24690.0	26990.0	29530.0	31680.0
16FEB86, 1900;	34020.0	36820.0	39070.0	43770.0	47990.0	48850.0
17FEB86, 0100;	47690.0	47830.0	47640.0	49750.0	51640.0	51710.0

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17FEB86, 0700;	57040.0	59290.0	62490.0	63020.0	67170.0	73740.0
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18FEB86, 0700;	116600.0	120700.0	123600.0	124600.0	127500.0	127900.0
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18FEB86, 1900;	126600.0	127400.0	128500.0	130700.0	132100.0	131700.0
19FEB86, 0100;	131000.0	130400.0	131000.0	129100.0	127900.0	127400.0
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19FEB86, 1900;	130400.0	131800.0	129700.0	130300.0	128300.0	128200.0
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20FEB86, 1900;	104300.0	103700.0	100200.0	98890.0	99170.0	98610.0
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21FEB86, 1300;	81560.0	80800.0	78710.0	75350.0	72550.0	70260.0
21FEB86, 1900;	70650.0	66640.0	64910.0	62110.0	60030.0	56890.0
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22FEB86, 0700;	45960.0	47120.0	47380.0	46860.0	46080.0	46080.0

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22FEB86, 1300;	45830.0	45760.0	46990.0	46860.0	45890.0	45760.0
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23FEB86, 0100;	45960.0	45190.0	45380.0	45250.0	45250.0	45860.0
23FEB86, 0700;	46150.0	46340.0	45060.0	46020.0	46530.0	44940.0
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23FEB86, 1900;	42260.0	42440.0	41890.0	40560.0	38610.0	38260.0
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Units: FEET Type: INST-VAL

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13FEB86, 1900;	16.410	16.500	16.580	16.710	16.910	17.290
14FEB86, 0100;	17.910	18.470	19.010	19.520	19.880	20.080
14FEB86, 0700;	20.200	20.300	20.370	20.430	20.470	20.520
14FEB86, 1300;	20.560	20.600	20.690	20.750	20.780	20.800
14FEB86, 1900;	20.810	20.830	20.870	21.070	21.360	21.690
15FEB86, 0100;	21.990	22.200	22.560	22.560	22.800	22.960
15FEB86, 0700;	23.060	23.100	23.150	23.230	23.320	23.400
15FEB86, 1300;	23.470	23.550	23.610	23.730	23.820	23.890
15FEB86, 1900;	24.000	24.080	24.170	24.300	24.400	24.520
16FEB86, 0100;	24.640	24.760	24.870	24.990	25.100	25.210
16FEB86, 0700;	25.340	25.430	25.520	25.630	25.750	25.840
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17FEB86, 0100;	31.370	31.830	32.150	32.370	32.440	32.410

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17FEB86, 0700;	32.450	32.590	32.830	33.170	33.500	33.830
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18FEB86, 0100;	38.770	38.900	38.940	39.000	38.970	39.090
18FEB86, 0700;	39.090	39.100	39.170	39.220	39.320	39.520
18FEB86, 1300;	39.550	39.650	39.670	39.800	39.840	39.820
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19FEB86, 0100;	40.370	40.280	40.330	40.310	40.370	40.270
19FEB86, 0700;	40.210	40.180	40.140	40.280	40.300	40.300
19FEB86, 1300;	40.320	40.300	40.330	40.330	40.340	40.370
19FEB86, 1900;	40.260	40.270	40.240	40.240	40.210	40.270
20FEB86, 0100;	40.210	40.210	40.230	40.170	40.220	40.210
20FEB86, 0700;	40.110	40.010	40.000	39.800	39.720	39.540
20FEB86, 1300;	39.360	39.290	39.100	38.910	38.780	38.610
20FEB86, 1900;	38.650	38.510	38.460	38.400	38.290	38.150
21FEB86, 0100;	38.130	38.130	38.060	37.990	37.950	37.920
21FEB86, 0700;	37.780	37.770	37.610	37.590	37.440	37.270
21FEB86, 1300;	37.110	36.900	36.690	36.470	36.200	36.010
21FEB86, 1900;	35.660	35.460	35.160	34.950	34.670	34.330

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Unrecognized Command:
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American River Watershed Investigation, California

APPENDIX R

Incremental Analysis

AMERICAN RIVER WATERSHED INVESTIGATION, CALIFORNIA

FEASIBILITY REPORT

APPENDIX R

WILDLIFE MITIGATION INCREMENTAL ANALYSIS

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WILDLIFE MITIGATION INCREMENTAL ANALYSIS

Purpose: The purpose of this report is to document the mitigation alternatives that were considered in formulating a wildlife mitigation plan to offset project impacts. Alternatives are described and evaluated according to cost and mitigation output. A least-cost mitigation plan is recommended based on an incremental analysis of mitigation alternatives as required by Corps regulation (ER 1105-2-100, ER 1105-2-185).

Abstract:

Impacts: Project impacts to fish and wildlife habitats occur at the dam inundation area and at Natomas construction areas. Dam inundation area (4,000 acres) impacts an equivalent total of 1,927 acres after 108 years of 1,010 acres on an average annual basis resulting in loss of 726 average annual habitat units (AAHU). Natomas construction impacts 290 acres of wetland and upland habitat resulting in a loss of 212 habitat units (HU). In addition to these general fish and wildlife resources impacts, the dam inundation area will adversely impact an estimated 9,882 elderberry shrubs which is habitat for the threatened valley elderberry longhorn beetle.

Mitigation: Based on an evaluation of mitigation alternatives, dam construction and operation impacts of 726 AAHU's can be mitigation most cost effectively by (1) onsite mitigation on project lands (specific measures to be identified in Ped); (2) acquisition and passive management of 2,685 acres along the South Fork of the American River; and (3) implementation of an Adaptive Management Plan to monitor impacts and provide mitigation in the event actual impacts exceed predicted impacts. The Fish and Wildlife Service has rendered a Biological Opinion pursuant to the Endangered Species Act requiring an additional 2,700 acres of land be acquired and planted with 32,336 replacement elderberry shrubs for the threatened beetle. Mitigation objectives can best be met by combining together the 2,700-acres area for the threatened valley elderberry longhorn beetle with the proposed 2,685-acre mitigation area on the South Fork of the American River. This is a total of 5,385 acres for mitigation of dam inundation area and construction impacts. For the direct loss of 290 acres of wetland and upland habitat in the Natomas area, creation of a 280-acres wetland/upland mitigation area in east Natomas appears to be the most cost effective means of providing mitigation. Thus total mitigation lands are 5,665 acres for the project.

AMERICAN RIVER WATERSHED INVESTIGATION, CALIFORNIA

WILDLIFE MITIGATION INCREMENTAL ANALYSIS

I. INTRODUCTION

The proposed American River flood control project will have significant impacts to fish and wildlife. This report compares the cost effectiveness of potential mitigation alternatives and the capability of these alternatives to accomplish mitigation objectives. Incremental analysis is required to support recommendations for fish and wildlife mitigation measures involving compensation. A mitigation plan is included in the recommended flood control plan to compensate for fish and wildlife impacts to an "appropriate and justifiable" level of mitigation.

Project features which should be mitigated include a 545,000 acre-foot flood detention dam on the American River and levee and channel improvements downstream in the vicinity of Natomas. Project construction and operation will adversely affect 4,019 acres and result in the loss of 1,927 acres after 108 years or 1,010 acres on an average annual basis to riverine canyon and upland wildlife habitat. Natomas vicinity flood control improvements will cause the direct loss of 290 acres of riparian/wetland and upland habitat. Habitat Evaluation Procedures were conducted to translate the loss of acreage to quantitative habitat values (average annual habitat units) and evaluate potential mitigation alternatives.

The Corps proposes mitigation measures to compensate for significant fish and wildlife impacts. The wildife resources which would be impacted are considered significant and the extent of impact justifies the inclusion of compensatory mitigation measures. The U.S. Fish and Wildlife Service (FWS) has designated the resources of the dam site and Natomas area as Resource Category 2 for which they recommend no net loss of in-kind habitat value. The FWS has recommended that 51,987 acres of land be acquired for fish and wildlife mitigation to offset the detention dam's construction and operation impacts. The Corps does not concur with the FWS. Acquisition and development of 51,987 acres is not justified given the cost and the significance of the impacts involved. The FWS recommends that for direct and indirect impacts to wetland and upland habitat in the Natomas area that 17,650 acres in Natomas be acquired and developed into a wetland-upland complex. The Corps proposes to mitigate only the direct impacts in Natomas. Indirect impacts related to future growth inducement after project construction are the responsibility of the local sponsor to mitigate.

The information presented in this report indicates that the

acquisition and management of a 2,685 acre mitigation area along the South Fork of the American River will adequately mitigate for the equivalent loss of 1,927 acres (1,010 acres average annual) of wildlife habitat. For the direct loss of 290 acres of wetland and upland habitat in the vicinity of Natomas, a 280-acre wetland/upland mitigation area is proposed in Natomas near the Natomas East Main Drainage Canal.

Separate from general fish and wildife mitigation, the FWS has rendered a biological opinion requiring that 2,700 acres of lands be acquired on the South Fork of the American River for the planting of 32,336 elderberry plants, habitat for the threatened valley elderberry longhorn beetle (VELB). This 2,700-acre area will be combined with the 2,685-acre general fish and wildife mitigation area on the South Fork. The biological need for separate lands for the VELB and other aspects will be confirmed with the FWS at the preconstruction engineering and design (PED) stage.

II. PROJECT FEATURES

The following selected plan features provide 200-year flood protection:

a. A 545,000 acre-foot flood detention dam on the American River near Auburn. Inundation during flood events and project construction features will adversely affect 4,019 acres.

b. Levee, channel, and related flood control improvements at several locations around the Natomas area, Arcade Creek, and along lower Dry Creek. These construction features will cause direct adverse impacts to 290 acres.

c. Maintenance of existing flood control capacity and operation of Folsom Reservoir and Dam.

d. Pedestrian/bicycle and equestrian trails along project features in the Natomas area.

Construction of (a) and (b) above are the major features of the proposed project having significant impacts to fish and wildlife over the 100-year life period of analysis -- 108 years including the construction period. Both direct (resulting from construction and maintenance) and indirect impacts (impacts occurring later in time or different location) result from these features. Operation impacts related to growth inducement downstream in Natomas are the responsibility of the local sponsor to provide appropriate mitigation. Indirect impacts from the dam result primarily from reservoir filling and slope sloughing

during drawdown of stored flood waters. Table 1 summarizes the impacts of dam construction and operation, and Natomas area channel and levee improvements. This summary is an estimate of impacts caused by physical construction, by physiological damage to plants from inundation, and by physical damage to plants from slope sloughing. For details of these impacts, see Chapter 7 on fish, vegetation and wildlife and Apppendix Q on inundation impact analysis.

TABLE 1
COVER TYPE ACREAGE LOST FROM PROJECT CONSTRUCTION AND OPERATION

	COVER TYPES								Total Acreage
	So. Slope Oak Woodland	No. Slope Oak Woodland	Chaparral	Conifer Forest	Grassland	Montane Riverine	Riparian/ Wetland	Upland	
Existing Acreage	1,251.2	1,269.0	170.0	210.0	156.8	962.0	NA[1]	NA[1]	4,019
DAM IMPACTS									
Ponderosa Bridge	1.0	2.1	0.8						3.9
Highway 49 Realignment	13.1	12.5	9.3	2.5					26.4
Auburn Dam Site	10.4	31.0			136.5	23.9			166.8
Aggregate Quarry	10.4	6.2	6.8		6.0				29.4
Inundation Impacts	550.0	551.0	163.0	90.0	23.0	277.0			1,700[2]
Total	584.9	602.8	179.9	92.5	165.5	300.9			1,926.5
NATOMAS AREA									
							18	272	290

1/ NA - Not Available
2/ Includes 46 acres of Rocky Ruderal

III. IMPACTS

The proposed flood control detention dam on the Middle Fork of the American River and flood control improvements in the vicinity of Natomas will have significant impacts to fish and wildlife. The following fish and wildlife impacts are considered significant and are proposed for mitigation:

a. Upper American River. - A total of 4,000 acres exists within the potential inundation zone. The potential impacts to these 4,000 acres are due to three factors (1) construction, (2) inundation, and (3) slope sloughing. A permanent loss of 227 acres are estimated to occur from construction. Of these 227 acres, 208 are within the inundation zone and 19 outside the zone are estimated to occur from the aggregate system. The remaining 3,792 acres in the inundation area are susceptible to inundation and slope sloughing. An analysis was done to determine the actual impacts to the remaining 3,792 acres. The impact analysis included information from the California Department of Water Resources study on slope failure which was developed for this project. Inundation information was based on expected physiological and physical impacts estimated from scientific literature, anecdotal evidence at analog sites, and a set of assumptions detailed in the inundation impact analysis in Appendix Q. Although all acres subject to inundation would be subject to inundation impacts, the lower elevation areas will be inundated more frequently receiving more impacts. Analysis of this variable impact and of remaining or regrowing habitat values between inundation events results in an estimated equivalent acreage loss of habitat value. The partial and variable losses in the 3,792 acre inundation area is equivalent to a total loss of 1,700 acres, 600 for inundation and 1,100 for slope sloughing. The total impact to the inundation area of the project would be 1,908 acres (208 permanent construction acres impacted and 1,700 inundation acres impacted). In addition, the 19 acres outside the inundation area brings the total loss of wildlife habitat to 1,927 acres. Annualizing the acreage loss of 1,927 acres over the 108-year period of analysis gives an annualized acreage loss of 1,010 acres as depicted in Figure 1. This is the objective for mitigation, but the habitat values need to be considered and analyzed as explained below in this section. Appendix Q Section 6.0 explains in detail the methodologies used in the impact analysis. The six cover types impacted in the detention dam area are oak woodland, chaparral, conifer forest, grassland, and montane riverine habitat.

Resource Significance: Wildlife resources of the American River canyon are considered by the FWS (Auburn Area, Substantiating Report, February 1991) to be ". . . extremely important ecological areas . . . scarce and of high value on a

Detention Dam Acreage Impacts

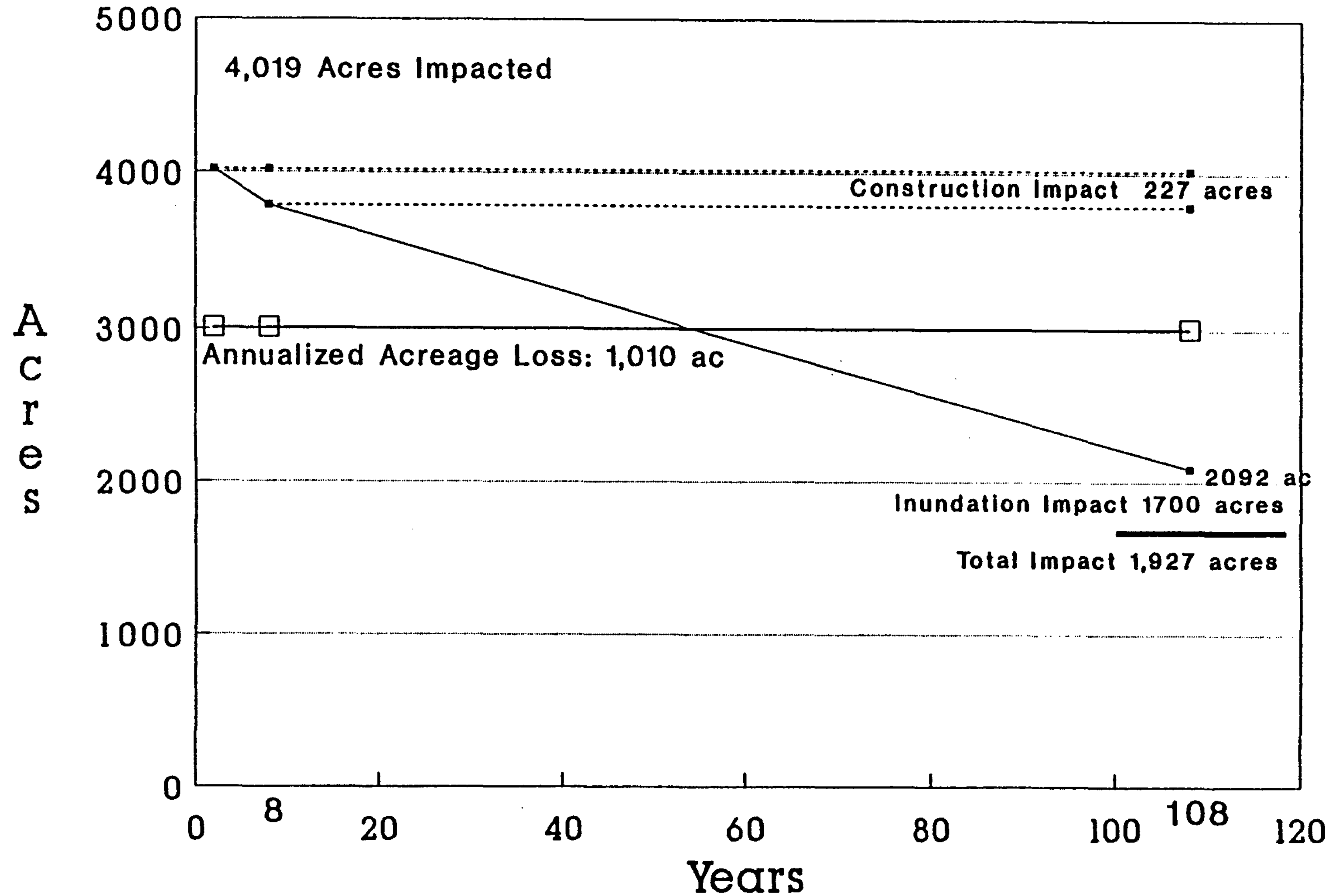


Figure 1

local and regional basis. . . ." No net loss of in-kind habitat value is recommended by the FWS (Resource Category 2).

b. Natomas Area and Lower Dry Creek. - Levee and channel improvements will result in the loss of 290 acres of wetland/riparian habitats and upland habitat composed of rice and grain fields, pasture, and grasslands.

Resource Significance: Riparian and wetland habitats are significant wildlife habitats. Their importance is based on their value to wildlife and their local and regional scarcity. The FWS recommends no net loss of in-kind habitat value (Resource Category 2).

Habitat Evaluation Procedures (HEP) were used to evaluate project impacts to wildlife habitat values. The HEP methodology determines the value of particular cover types to specific evaluation species based on a Habitat Suitability Index (HSI). Evaluation species are selected to represent overall significant wildlife habitat needs including those of other species. An HSI is a field measurement of various physical and vegetative conditions of the habitat and evaluation of these conditions in meeting the life requisites of the evaluation species. In the HEP analysis, the evaluation species were tracked over the 108-year period of analysis under the without-project scenario and the with-project scenario at the dam site.

The HEP report prepared by FWS (see Appendix S) to address the impacts of the detention dam listed the net change ($AAHU_{WITHOUT} - AAHU_{WITH}$ = NET IMPACT) in average annual habitat units (AAHU'S) for each evaluation species. Summing the net change for each of the thirty-one evaluation species yielded a total net loss of 2,902.2 AAHU's (441.19 AAHU's from construction and 2,461 AAHU's from operation). Because of the large number of evaluation species included in the HEP, this figure is not of great importance. Simply adding more species increases the total loss of AAHU's. As discussed in the next section, what is important is that the FWS recommended 51,987 acres of mitigation acreage based on the individual species with highest acreage mitigation requirement.

After evaluating the HEP report prepared by the FWS and carefully considering the recommendation of the FWS, a decision was made by the Corps that the mitigation recommendations of the Service were not justified. Based on the 1,010 average annual equivalent acres lost, the FWS recommended a 52-to-1 mitigation ratio of 51,987 acres. The Corps determined that a different approach was needed to analyze project impacts and mitigation objectives to obtain justifiable mitigation. Rather than looking at individual species, emphasis was given to determining the average quality of the habitat in meeting the life requisites of

the species. Using the HEP data, a composite HSI value was determined for each of the 6 cover types impacted by the project by averaging the HSI's for the evaluation species within each cover type. The composite HSI value for each cover type was then multiplied by the estimated acreage that would be lost as a result of the project. The resulting values (habitat units) quantitatively describe habitat losses for each of the cover types, the overall project impact, and the mitigation objective.

Using this methodology, it was determined that for the loss of 1,927 acres of six cover types at the detention dam area, 1,391.71 habitat units would be lost as a result of dam construction and operation (Table 2). Habitat units were summed over the period of analysis and annualized for the with-project condition and the without-project condition to determine the net average annual habitat unit impact of the project. The net annual impact of dam construction and operation is calculated by using the formula: $AAHU_{WITHOUT} - AAHU_{WITH} = NET\ IMPACT$; 1,391.71 - 665.4 = 726.31 (net impact). With the project 665.4 AAHU's will be lost over the period of analysis. Under the without-project condition the assumption is made that habitat values will remain unchanged over the period of analysis. The net impact figure reflects in AAHU's the difference between future with and without the proposed action conditions. An average of 726.31 fewer HU's will be available for wildlife every year during the life of the proposed project than would be available if the proposed project was not implemented. Figure 2 illustrates this relationship.

Similarly, for Natomas-area impacts, 212 habitat units must be provided in-kind to offset the loss of 290 acres of riparian/wetland and upland habitat (Table 2).

TABLE 2
ESTIMATED LOSS OF HABITAT UNITS AND ACREAGE FROM THE PROJECT

COVER TYPE	HSI VALUE	ACREAGE	HUs	AVERAGE ANNUAL HUs
UPPER AMERICAN R.				
South Slope Oak Woodland	0.77	584.9	450.37	235.0
North Slope Oak Woodland	0.59	602.8	355.65	185.6
Chaparral	0.85	179.9	152.92	79.8
Coniferous Forest	0.77	92.5	71.23	37.2
Grassland	0.73	165.5	120.82	63.1
Montane Riverine	0.80	300.9	240.72	125.6
TOTAL		1,926.5	1391.71	726.31
NATOMAS AREA				
Riparian/Wetland	0.58	18	10.44	10.44
Uplands (grains, grassland)	0.74	272	201.28	201.28
TOTAL		290	211.72	211.72

Relationship of With-Project and Without -Project Conditions and Net Impact

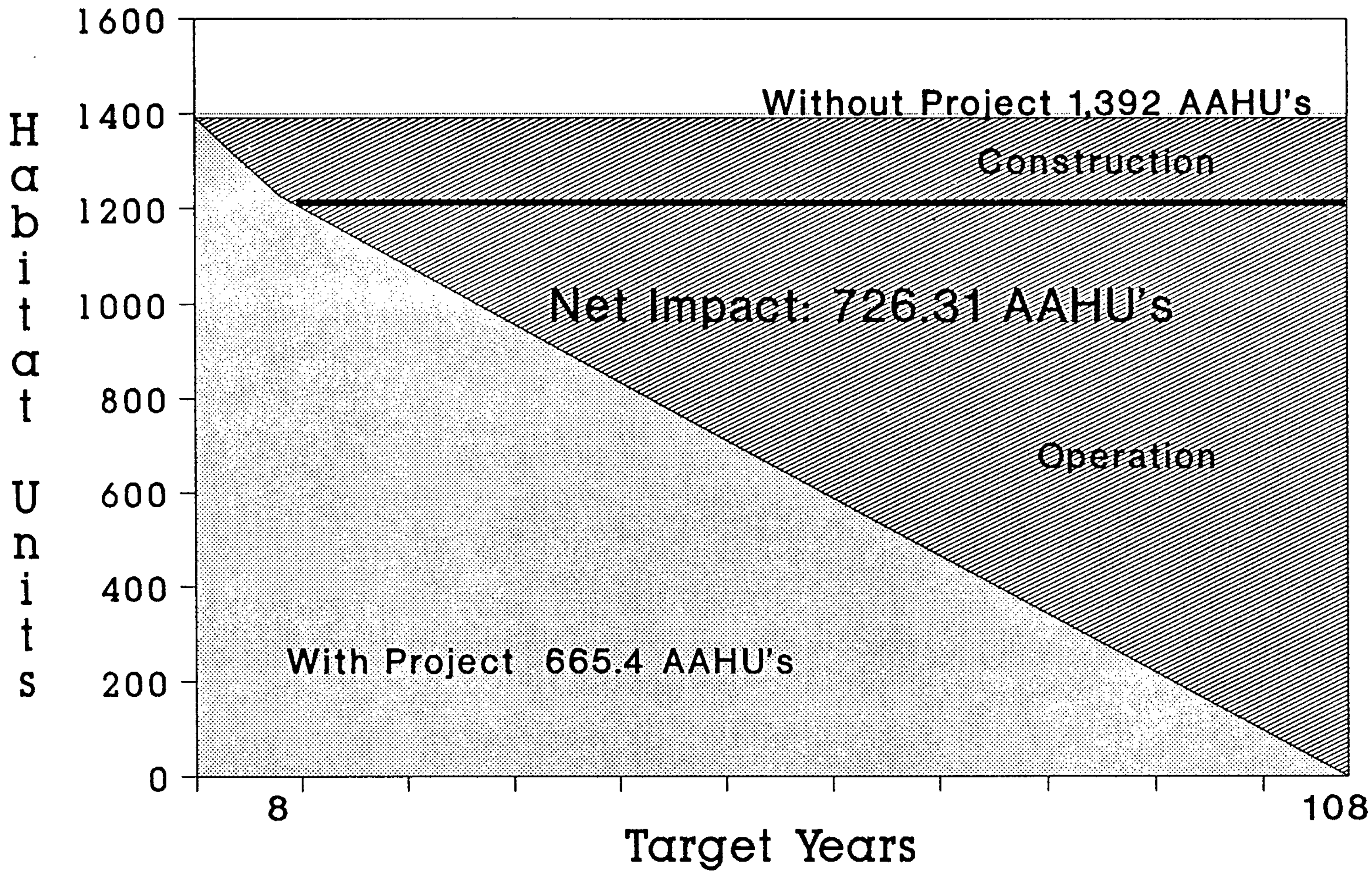


Figure 2

IV. MITIGATION ALTERNATIVES

A number of mitigation options were identified during the formulation of a mitigation plan. The mitigation objective is the replacement of individual cover type habitat values. Table 2 lists the net AAHU's lost for each cover type. The mitigation options listed below were identified for compensating for impacts from the detention dam and channel and levee improvements in Natomas. These two areas are treated separately because the habitat types proposed for mitigation are not comparable due their different location, and physical and ecological characteristics. The mitigation options are listed in order of desirability based on cost and ability to provide similar habitat values to those values lost at the dam site and in the Natomas area.

Upper American River

1. **Acquisition of South Fork Lands, Passive Management, and Mitigation on Project Lands.** Acquisition of existing high value habitats on South Fork is the principal element of this alternative. Passive management measures (e.g., cattle removal) will be added if found cost effective to reduce lands costs. Also, mitigation on project lands would be substituted to a limited extent if found more cost effective.

2. **Adaptive Management Plan.** A plan to monitor vegetative losses in the detention basin and provide compensatory mitigation if vegetetative losses are found during project operation to exceed impact predictions.

3. **Active Management of South Fork Lands.** Management measures (cattle removal, burn program, and riparian forest, oak woodland and pine forest restoration) of lands threatened by development on the South Fork of the American River will be added if found more cost effective and lands costs will be reduced.

4. **U.S. Fish and Wildlife Service Recommended Mitigation.** Acquisition and management of 51,987 acres along the South Fork of the American River for fish and wildife mitigation.

5. **Knickerbocker Lands.** Management of lands of the Bureau of Reclamation for improved wildlife values.

6. **Cosumnes River.** Lands along the Consumnes River would be acquired and managed for fish and wildlife.

Natomas Area

7. **North Natomas Wetland/Upland Habitat Development.** Conversion of agricultural lands to wetland/upland habitat.

8. **Natomas Wetland/Upland Development.** Alternative location to be identified in PED.

9. **Wetland/Upland Habitat Development outside Natomas.** Offsite location to be identified in PED.

Alternatives 1 and 2 listed above combined together constitute the proposed mitigation plan. These two measures are discussed below in greater detail than the other alternatives which are expected to be less cost effective. Further biological data and cost information is needed regarding the alternatives 3, 4, 5, and 6 before making a final determination. However, based on preliminary examination, these 4 alternatives are predicted to have a higher cost per habitat unit, or not provide in-kind habitat values to those values lost at the dam site.

Upper American River.

1. **Acquisition of Lands Threatened by Development on the South Fork of the American River, Passive Management, and Mitigation on Project Lands.** Acquisition of lands along the South Fork of the American River is the principal recommended wildife mitigation plan. Based on an analysis described below, acquisition of 2,685 acres South Fork land will accomplish the mitigation objective of 726.31 AAHU's (net impact of the dam). If no mitigation opportunities are found to exist at the dam site for further reducing costs, this measure has the potential of fully compensating for dam impacts most cost effectively.

Privately owned lands along the South Fork have the best potential for offsite mitigation because these lands are likely to be developed in the near future and their habitat values largely lost. Land use studies estimate that full buildout of these lands will take place within 30 years. Under the development scenario (without project or without mitigation condition) of full buildout of lands, habitat values are expected to significantly decrease by year 30. The assumption is that the continuing level of habitat quality between year 30 and 108 will be 20 percent of current levels. Therefore, up to 80 percent of the current habitat value can be credited to mitigation by acquiring these lands and preserving them and this will provide very effective mitigation value. The effectiveness results from the existing high habitat values of mature vegetation providing mitigation credit as compared to the alternative of planting new vegetation which takes considerable time to reach maturity and develop full mitigation value.

The South Fork was incuded in the HEP analysis as a potential mitigation site. One area, 2,330 acres in size, has been examined in field studies and analysed using HEP. This area generally has lower HSI values than the proposed project dam and inundation site for the south slope oak woodland, grassland, and montane riverine habitat due to grazing and other land uses. Table 3 shows the mix of cover types found in this area and average cover type HSI values. Compared to the dam site there is proportionally less north slope oak woodland habitat than south slope due to the gentler slopes along the South Fork. The riparian band of vegetation along the South Fork mitigation area is narrow. Expansion potential of this band is limited due to grazing which limits recruitment of young seedlings (FWS Aurburn Area HEP Report, November 1991). An estimated 1,245 habitat units were calculated for this area based on average HSI values determined for the different cover types. Other areas adjoining the sampled area are assumed to have similar cover type acreages and HSI values. Acquiring a large number of acres in the mix of cover types similar to mix of cover types lost at the dam site will provide acceptable means of cost effective mitigation.

The total lands needed to provide preservation credit to achieve the goal of 726.31 AAHU's (net project impact and mitigation goal) were calculated using the formula: NET PRESERVATION IMPACT = $AAHU_{WITH}$ - $AAHU_{WITHOUT}$; (mitigation goal) = 1,054.33 - 328.02 = 726.31. The net preservation figure reflects in AAHU's the difference between future with and without the project mitigation. An average of 726.31 more HU's will be available for wildlife every year during the life of the proposed project than would be available if South Fork lands were not acquired under the proposed mitigation. Under the without-project condition, 328.02 AAHU's is estimated to result using the land use expectation of full buildout and 80 percent loss of current habitat values by year 30. Under the with-project condition, 1,054.33 AAHU's would be provided through the acquisition of South Fork lands and result in a gain of 726.31 AAHU's. Figure 3 illustrates this relationship. The acreage needed to achieve 1,054.33 AAHU's is 2,685 acres. Table 4 lists the amount of in-kind acreage of individual cover types which should be acquired on the South Fork to replace the habitat values lost at the dam site, based on the existing HSI values in the South Fork area (Table 3). Field studies show that these acreages of the 6 habitats are available. Figure 4 shows the general area within which mitigation lands will be acquired. The estimated cost of lands is $7,304 per acre. This figure is based on a cost estimate of $30,056,454 for an area of 4,115 acres (cost estimate includes severance and a contingency of 25 percent). Based on these costs, 2,685 acres of land is estimated to cost $19.6 million (2,685 acres x $7,304/acre). Based on this cost, South Fork land acquisition has an estimated cost effectiveness of $27,000/AAHU (19.6 million/726 AAHU's).

TABLE 3
EXISTING HABITAT VALUES AT THE PROPOSED MITIGATION SITE
ON THE SOUTH FORK OF THE AMERICAN RIVER

COVER TYPE	HSI VALUE	ACREAGE	HABITAT UNITS
South Slope Oak Woodland	0.22	691.8	152
North Slope Oak Woodland	0.60	86.5	52
Chaparral	0.81	124.5	101
Conifer Forest	0.68	24.4	17
Grassland	0.67	1323.3	887
Montane Riverine	0.56	66.2	37
Disturbed	0	13.3	0
TOTAL		2,330.0	1,245.0

In order to obtain the mix of cover types, as shown in Table 4, within an area of 2,685 acres, these lands and the lands required for the establishment of habitat for the threatened valley elderberry longhorn beetle (VELB) will be located together. The FWS has issued a Biological Opinion for VELB requiring 14 reasonable and prudent alternatives/associated incidental take measures and conservation recommendations including the planting of 32,336 elderberry shrubs on 2,700 acres of separate lands. Therefore, a total area of 5,385 will be acquired as one contiguous block of land if possible, or in closely associated large blocks. Wildlife habitat values of continuous lands in one large block or in closely associated large blocks will be larger and more valuable for wildlife than several small blocks located separately.

In determining the mitigation value from preservation, habitat values were assumed to remain constant and not improve over time under the with-project condition as shown in Figure 4.

Although specific measures and costs are not known at this time, onsite mitigation is considered the most cost effective measure since land costs would be flood control costs not mitigation costs. The detention basin area within which mitigation measures could be located is about 4,000 acres; also, the project area includes a peripheral larger area totalling about 5,932 acres. No specific measures are proposed at this

Comparison of With-Project and Without-Project Conditions at South Fork

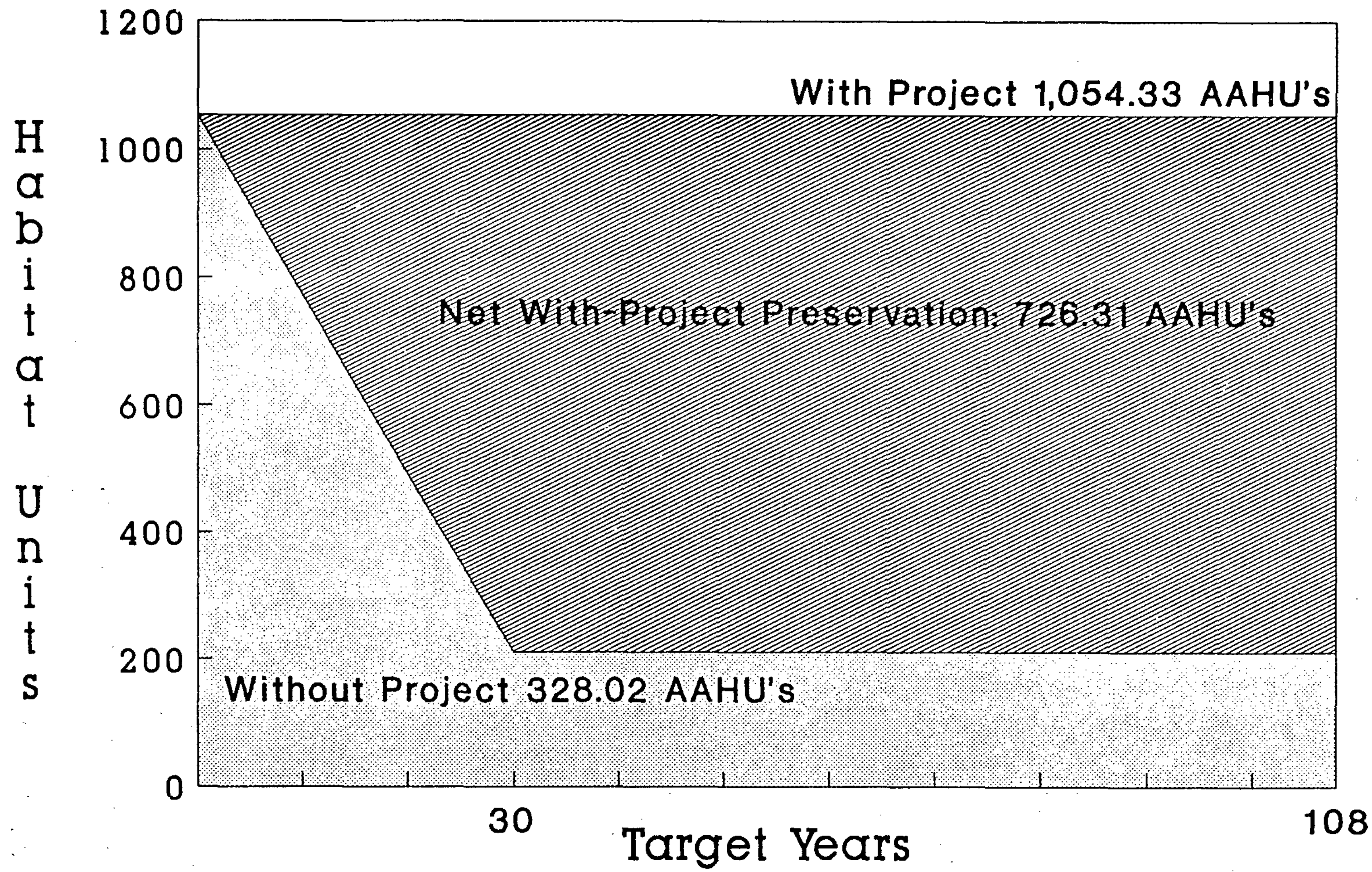
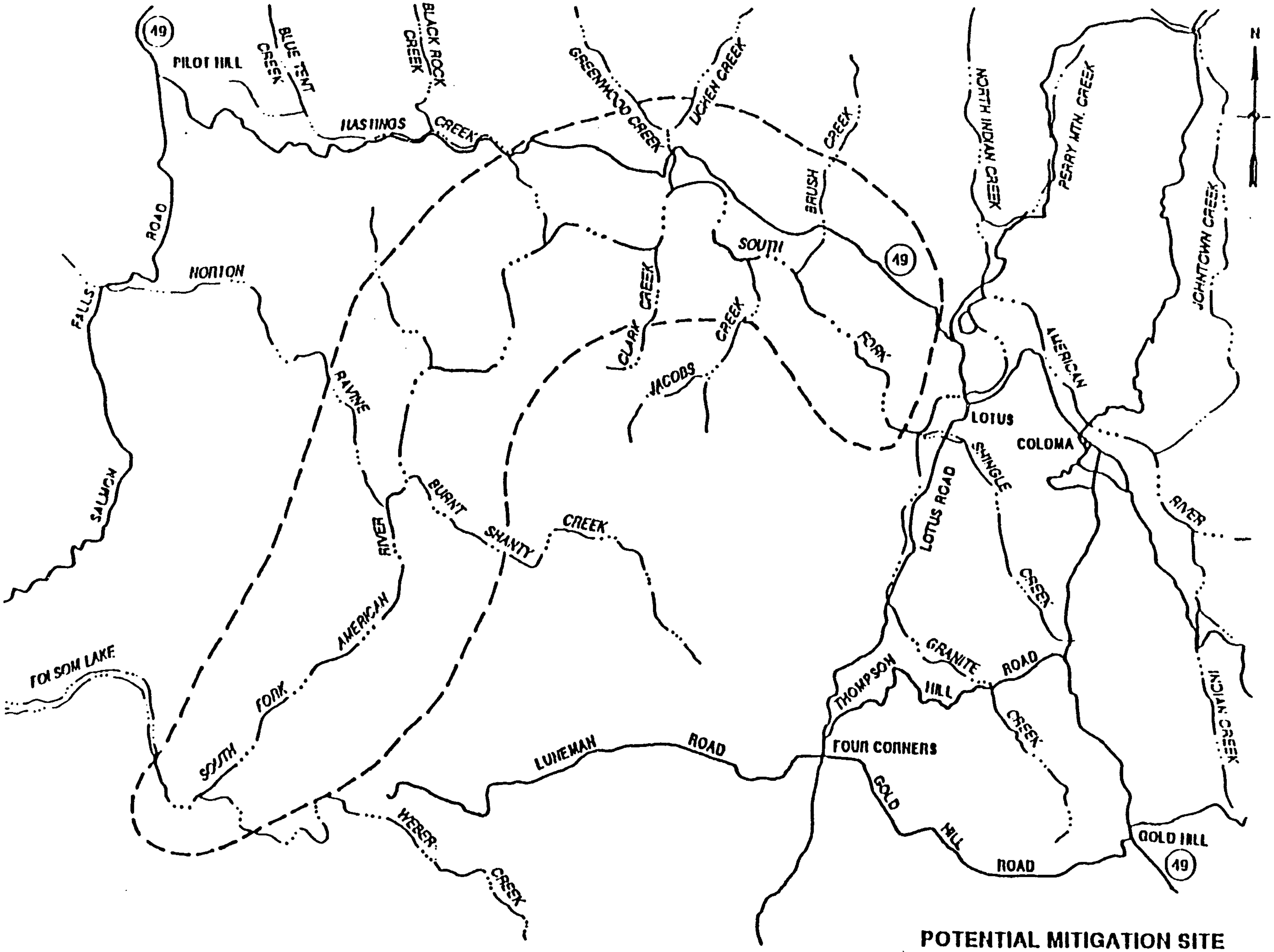


Figure 3

TABLE 4
ACREAGE NEEDS IN THE SOUTH FORK OF THE AMERICAN RIVER
BASED ON EXISTING HSI VALUES AND HABITAT UNIT REQUIREMENTS

COVER TYPE	HSI VALUE	ACREAGE NEEDED BASED ON EXISTING HSI	AVERAGE ANNUAL HABITAT UNITS NEEDED
South Slope Oak Woodland	0.22	1,550.9	341.2
North Slope Oak Woodland	0.60	449.2	269.5
Chaparral	0.81	143.1	115.9
Conifer Forest	0.68	79.4	54.0
Grassland	0.67	136.6	91.5
Montane Riverine	0.56	325.7	182.4
TOTAL		2,684.9	1,054.3

Note: In order to provide in-kind habitat replacement for the loss of 726.31 AAHU's, lands totaling 2,685 acres supporting the cover types in the acreages shown above must be acquired. A larger number of habitat units, 1,054 AAHU's, must be preserved under the project because under the without-project scenario some habitat values will still exist between over the 108-year period of analysis. Figure 3 illustrates this relationship.



POTENTIAL MITIGATION SITE
SOUTH FORK AMERICAN RIVER

SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

time. During PED, an effort will made to reduce offsite mitigation acreage and costs by locating mitigation to the maximum extent found cost effective at the project site on project lands. The following potential on-site mitigation measures will be investigated: mitigation plantings within the inundation area following flood events to provide short-term mitigation value; restoration and revegetation of the quarry site, staging areas, and other disturbed areas following construction; and placement of small check dams on small tributaries to form impoundments and conditions suitable for wetland establishment.

Fencing the South Fork mitigation area to remove grazing may improve habitat conditions for wildife. Much of the grassland in the area was formerly oak woodland that has been cleared and managed as grazing lands. These areas could over time convert back naturally to higher value historic conditions. Factors limiting habitat development and regeneration such as cattle grazing would be removed. Areas would be fenced to allow natural processes of natural revegetation and restoration. The mitigation value of removing grazing pressure, etc., will be examined in PED. Presently, no analysis of this has been conducted. If significant mitigation value is determined to result from passive management, less land will be acquired for mitigation to obtain the mitigation goal of 726 AAHU's.

2. **Adaptive Management Plan.** The purpose of the adaptive management plan is to deal with the uncertainity of vegetative losses due to slope failure and other causes in the detention basin. Of the 1,927 acres of vegetative loss anticipated from dam construction and operation, it is estimated that vegetative losses due to slope failure should not exceed 1,100 acres. Vegetative loss estimates have a degree of uncertainity because the reservoir will be periodically inundated with short-duration floods. As described in Appendix Q, the total slope sloughing could reach as high as 2,200 acres. This is based on soil factors alone. Analysis of vegetation effects such as roots holding the soils resulted in an estimate of 1,100 acres. Monitoring of vegetative losses during the operation of the project will take place to determine if the up-front mitigation is sufficient. In the event that future floods impact slope sloughing and vegetation in excess of pre-project impact predictions, vegetative losses will be evaluated and replaced. This adaptive management plan is not considered part of the up-front mitigation described in this report. It is considered an element of project operation and maintenance requirements. Although monitoring would take place, the plan would only provide replacement plantings or mitigation plantings when actual impacts are found to exceed impact predictions. If based on impact monitoring additional compensatory mitigation is needed, this will be provided by the project non-Federal sponsor as part of the O&M program. See Appendix Q for more information on the

Adaptive Management Plan.

3. **Active Management of South Fork Lands.** Under this alternative, active mitigation measures would be located on the South Fork mitigation area if found cost effective to reduce lands acquisition and costs. This alternative has only been developed conceptually. No actual costs or biological mitigation outputs have been developed for active management of South Fork lands. No specific measures have been developed at this time. Because land would be managed to get the most mitigation value per acre this means of providing mitigation has an advantage in that less land would have to be acquired to accomplish the mitigation objective. Preliminary analysis, however, indicates that intensive management is less cost effective than simple acquisision and passive management of acquired lands. Because South Fork lands are already of moderate quality (Table 3) there is less potential for increasing mitigation value through habitat enhancement than through acquisition and preservation. Newly created habitat takes many years to mature and provide significant mitigation value. Typically land costs of about $8,000 per acre are less than those for creating oak woodland which can be as much as $12,000 per acre for plants, site preparation, irrigation, and maintenance (Fugro-McClelland, 1991).

4. **U.S. Fish and Wildlife Service Recommended Mitigation.** The FWS has recommended that in order to mitigate for impacts to riverine canyon and upland wildlife habitat from dam construction and operation, 51,987 acres along the South Fork of the American River be acquired and managed for fish and wildlife (FWS Auburn Area Report, November 1991). The Corps does not concur with this recommendation. Given the annualized loss of 1,010 acres, 51,987 acres of mitigation gives a mitigation ratio of about 52-to-1 which is not justified. The FWS bases its recommendation on the findings of the HEP study and their mitigation policy of no net loss of in-kind habitat value for Resource Category 2 resources. The resources being impacted have been designated by the FWS as Resource Category 2. According to the FWS, in-kind mitigation in the HEP process requires using the compensation acreage for the species with the largest acreage requirements. Using the mitigation requirement of the species with the highest acreage requirement insures no net loss of in-kind habitat value (FWS HEP Report, November 1991). For operation impacts, the species with the largest acreage requirement is the American Dipper with 43,533 acres as shown in Figure 5. Including an additional 8,454 acres for construction impacts to the mourning dove, a total of 51,987 acres was calculated. Excluding land costs, costs for this are estimated by the FWS to be $164,850,000 for development and management and $200,000 annually for operation and maintenance. If land costs averaged $4,000 per acre, this would be over $200,000,000 and a total cost of over $370,000,000.

Compensation Acreage Requirements for Evaluation Species

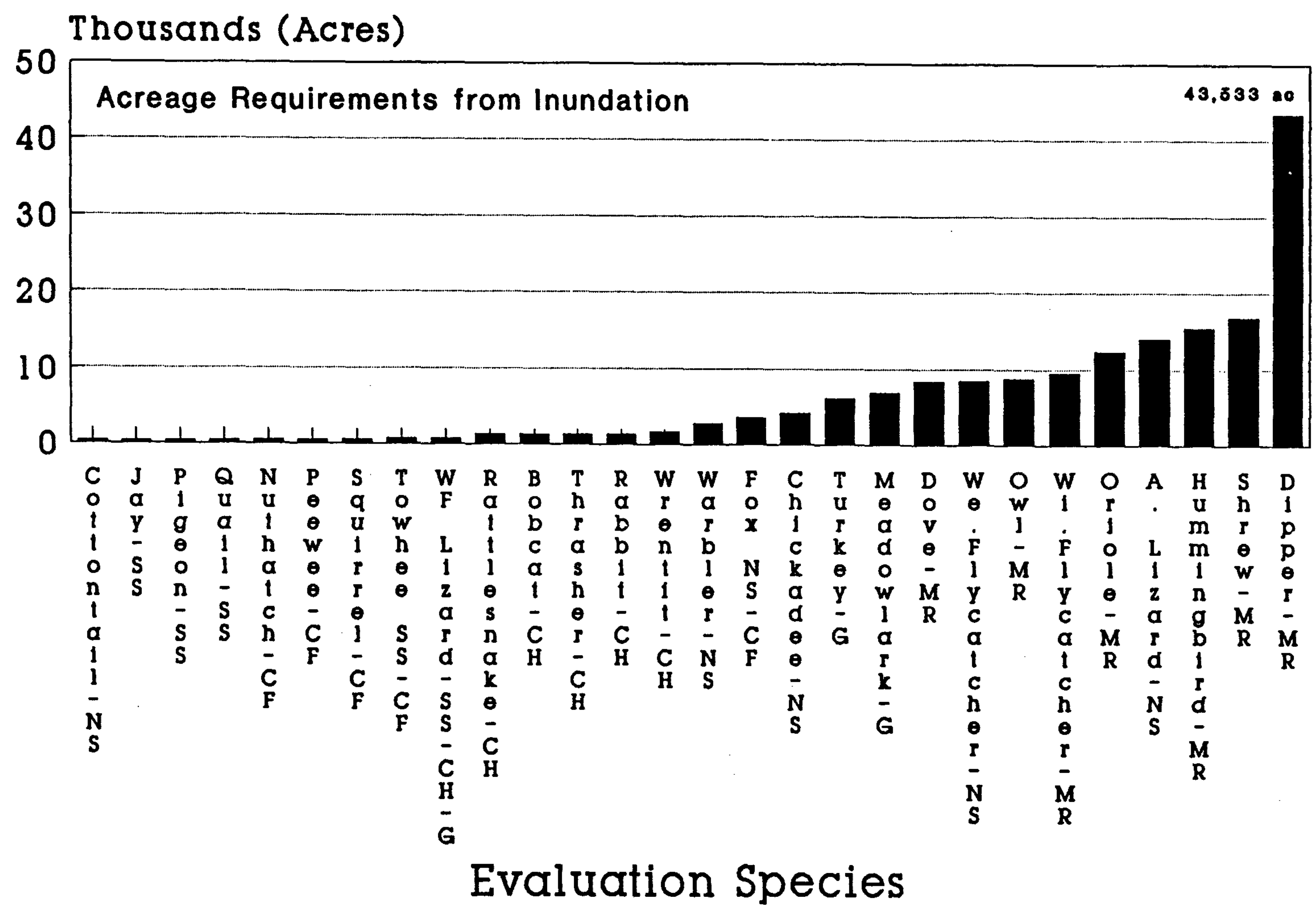


Figure 5

5. **Knickerbocker Lands.** Knickerbocker lands are lands owned by the Federal Government and managed by the Bureau of Reclamation. The lands total about 2,062 acres and are located near the town of Cool to the east of the dam site. Opportunities for mitigation at the site were evaluated and found to be limited. Habitat values are already relatively high and since the lands are presently in Government ownership they can be expected to improve without the project. Additionally, any mitigation value achieved through improved management or habitat enhancement is considered by the FWS to be out-of-kind mitigation because these lands differ in topographic and ecological features from habitats of riverine canyons. Because of these factors, the Corps concurs with the FWS that the site is unsuitable for mitigation.

6. **Cosumnes River.** Mitigation opportunities were examined along the main stem and the North Fork of the Cosumnes River at elevation zones similar to the dam site. Most of the cover types present in these areas of the Cosumnes River were found to be similar to those cover types that would be impacted in the North Fork and Middle Fork American River canyons. Opportunites for mitigation values were found to be limited because the existing habitat was generally of moderate to high value. Due to low potential for mitigation value from improvements a high compensation acreage ratio is expected giving this alternative a low cost effectiveness.

Natomas Area

1. **Natomas Wetland/Upland Habitat Development.** To compensate for the loss of 290 acres of wetland and upland habitat (Tables 1 and 2), 280 acres of agricultural lands in east Natomas near the Natomas East Main Drainage Canal will be converted to high value riparian/wetland and upland habitat. This 280 acres of mitigation will provide the necessary 212 HUs to compensate for the loss of 290 acres of wetland and upland habitat as described in the FWS Natomas Area report. The area is biologically suited to conversion because historically the area is believed to have been a wetland area before conversion to agricultural use. Planning stage designs propose 20 acres of riparian forest and riparian shrub-scrub, 101 acres of a combination of grain/alfalfa/rice, 151 acres of marsh and 8 acres of oak savanna. Land costs are $3,780,000 (includes a 20 percent contingency and severance damages) and facilities costs are estimated at 5,600,000. Based on these costs and a mitigation output of 212 habitat units, this alternative has an estimated cost effectiveness of $44,245/HU.

2. **Natomas Wetland/Upland Development.** Alternative locations in Natomas would have similar cost and mitigation value compared to the above alternative. During PED other sites will be examined

in more detail to determine if costs can be reduced.

3. **Wetland/Upland Habitat Development Outside Natomas.** No sites were identified outside of Natomas. These areas are likely to be of similar cost and less suited biologically for wetland/upland development.

V. CONCLUSION

The mitigation plan summarized below to compensate for Upper American River and the Natomas Area impacts appears to be the least cost means of achieving the mitigation objectives.

Upper American River

Dam construction and operation will result in the eventual equivalent loss of 1,927 acres (1,010 average annual equivalent acres) of montane riverine habitat, north slope oak woodland, south slope oak woodland, chapparal, conifer forest, and grassland habitat. Based on data from a HEP analysis conducted to determine impacts and mitigation requirements, this loss equates to a net impact of about 726 AAHU's for the six cover types. The mitigation objective is to replace habitat values lost for each of the six cover types to provide a total of 726 AAHU's.

Proposed Mitigation Plan Measures

a. Onsite mitigation measures to achieve in-kind habitat value replacement on project lands acquired for flood control. Specific measures will be identified during PED.

b. Acquisition and preservation of 2,685 acres of oak woodland, chaparral, conifer forest, grassland, and montane riverine habitats located on the South Fork of the American River in the mix of cover types as shown in Table 4. Less than the 2,685 acres of lands will be needed if mitigation is also accomplished in the detention basin area. If all mitigation is accomplished offsite on the South Fork, this measure would cost approximately $19.6 million. Approximately 726 AAHU's will result from this measure at a cost of $27,000/AAHU. The removal of grazing and other wildlife management measures to provide additional mitigation value will be examined in PED. The 2,700-acre area specified in the FWS biological opinion for the planting of 32,336 elderberry plants for the threatened valley elderberry longhorn beetle will be combined with this 2,685-acre

area. During PED, an analysis will be performed and coordinated with FWS to determine if the 2,685 acres for general fish and wildlife resources mitigation can also serve in whole or in part for endangered species needs and total lands requirements reduced.

c. An Adaptive Management Plan will be implemented to monitor the impacts of the project to determine if actual impacts have exceeded predicted impacts. If impacts are found to exceed predicted impacts, additional mitigation will be provided by the non-Federal sponsor at no cost to the Federal government.

d. Improvement of existing habitat quality through revegetation and other active management measures at the South Fork mitigation area. This could include conversion of grassland into more valuable north slope oak woodland habitat, montane riverine habitat, and conifer forest through revegetation and maintenance. This measure is not proposed but could be implemented if found to be more cost effective than the above measures. This was preliminarily determined to be less cost effective, but will be further examined in PED to see if mitigation costs can be reduced further.

Natomas Area

A 280-acre riparian/wetland and upland mitigation area will be developed in Natomas to compensate for the loss of 290 acres of riparian/wetland and upland habitat. At this time, the proposed conceptual 280-acre area consists of 20 acres of riparian forest and riparian shrub-scrub, 101 acres of a combination of grain/alfalfa/rice, 151 acres of marsh, and 8 acres of oak savanna. This measure has an estimated cost of $9,380,000 and a cost effectiveness of $44,245/HU. Other areas within and outside Natomas will be evaluated during PED for cost and biological suitability to reduce costs if possible and provide acceptable compensatory riparian/wetland and upland habitat.